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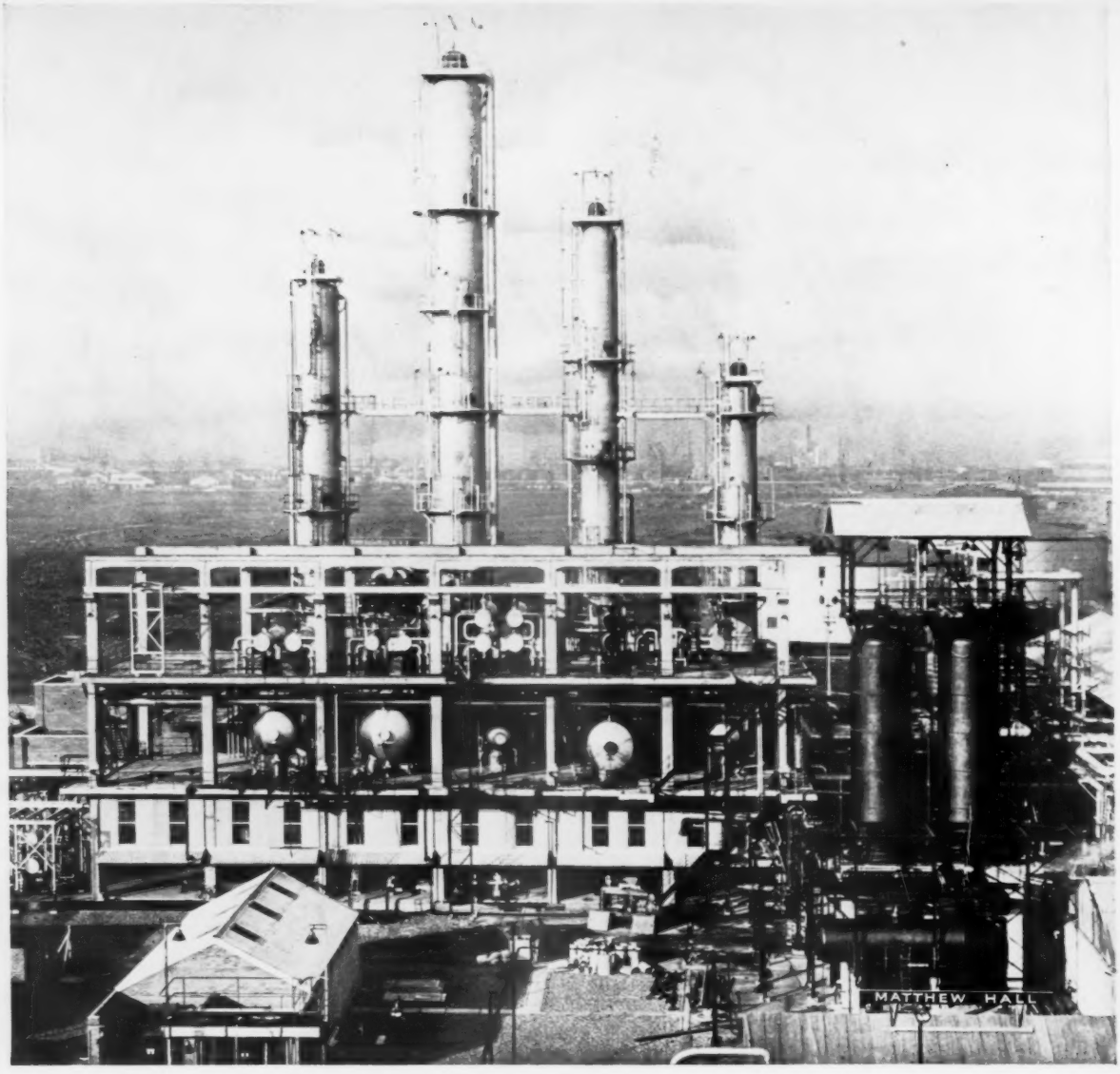


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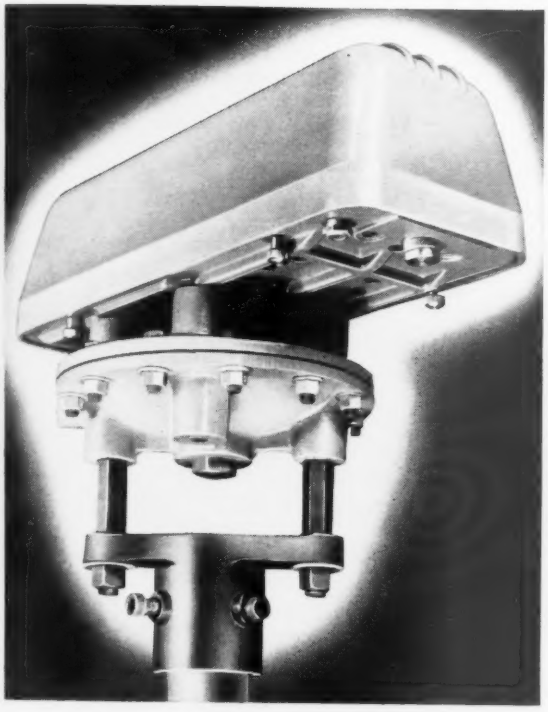

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Vol. 9, No. 101 May 1955

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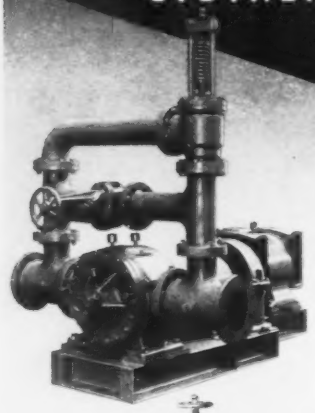

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(Below)
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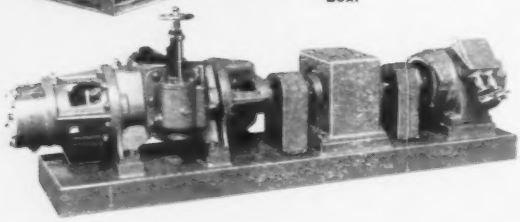

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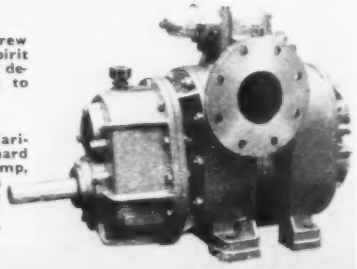

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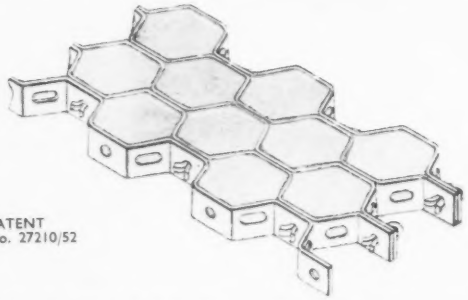

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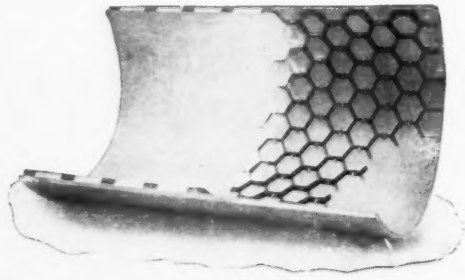

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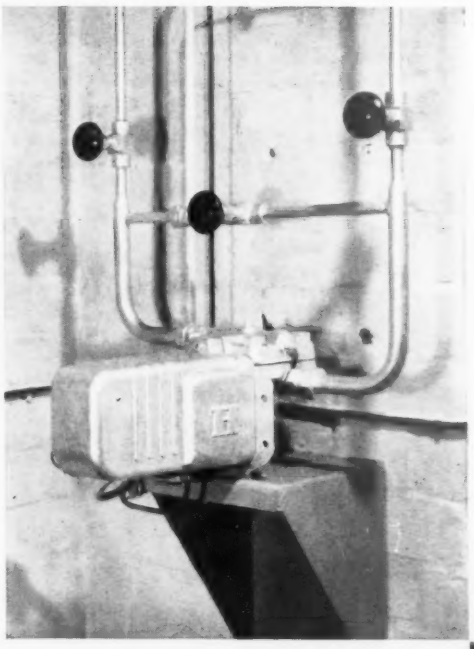

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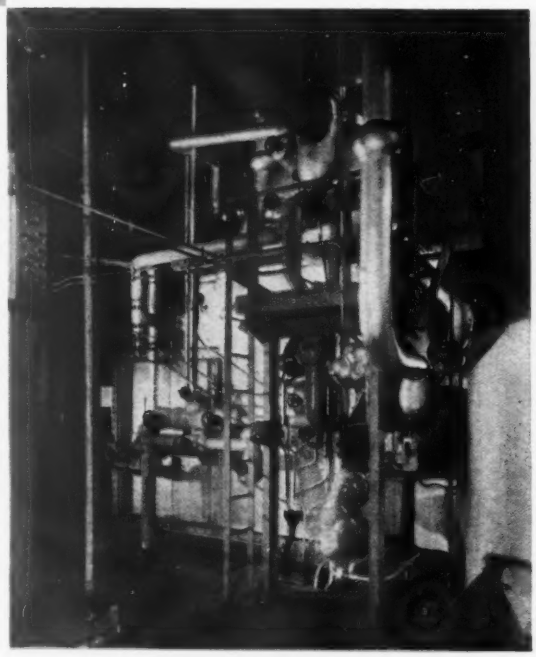

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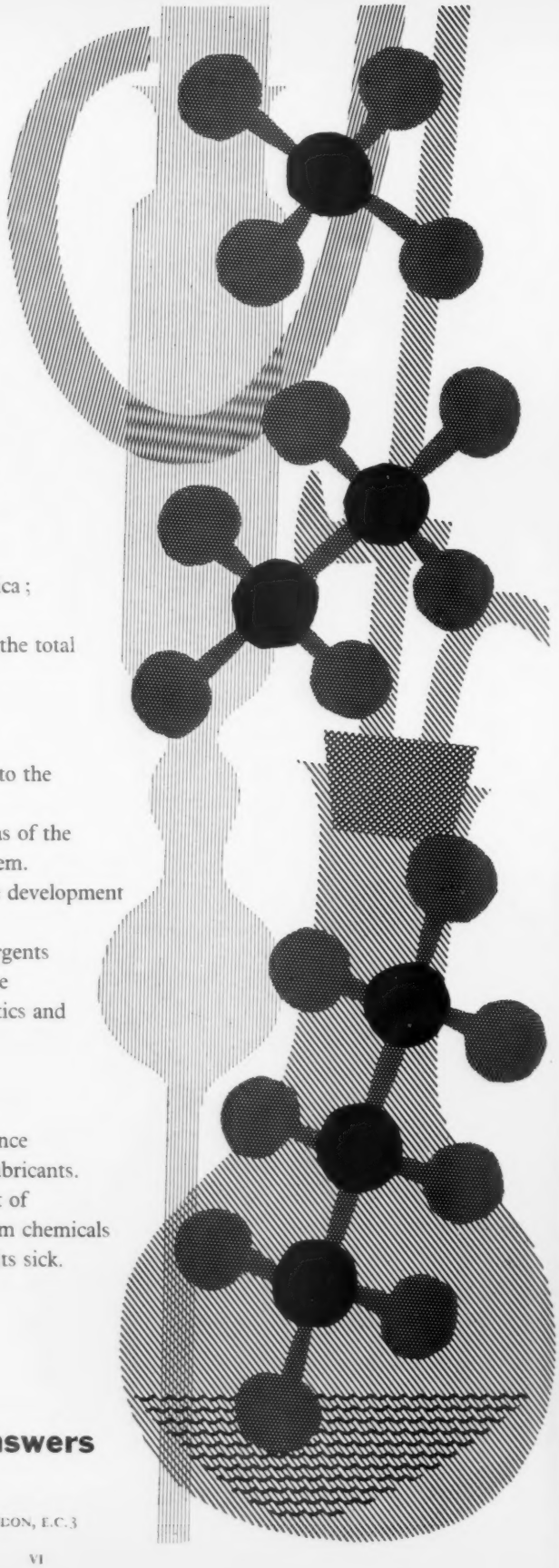

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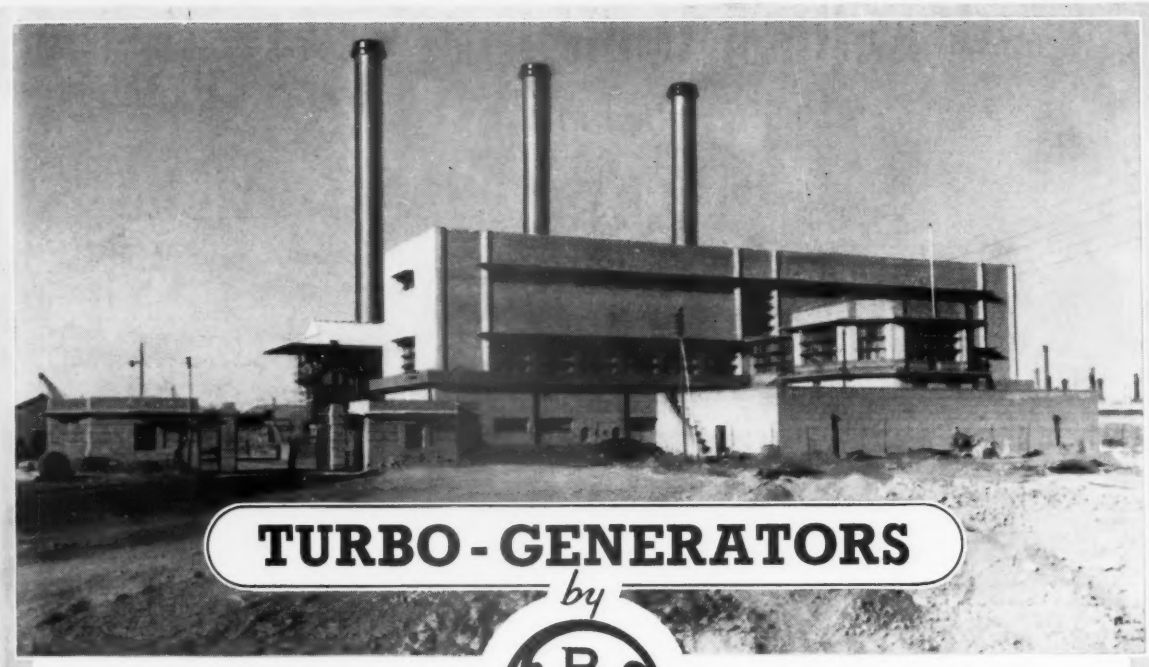

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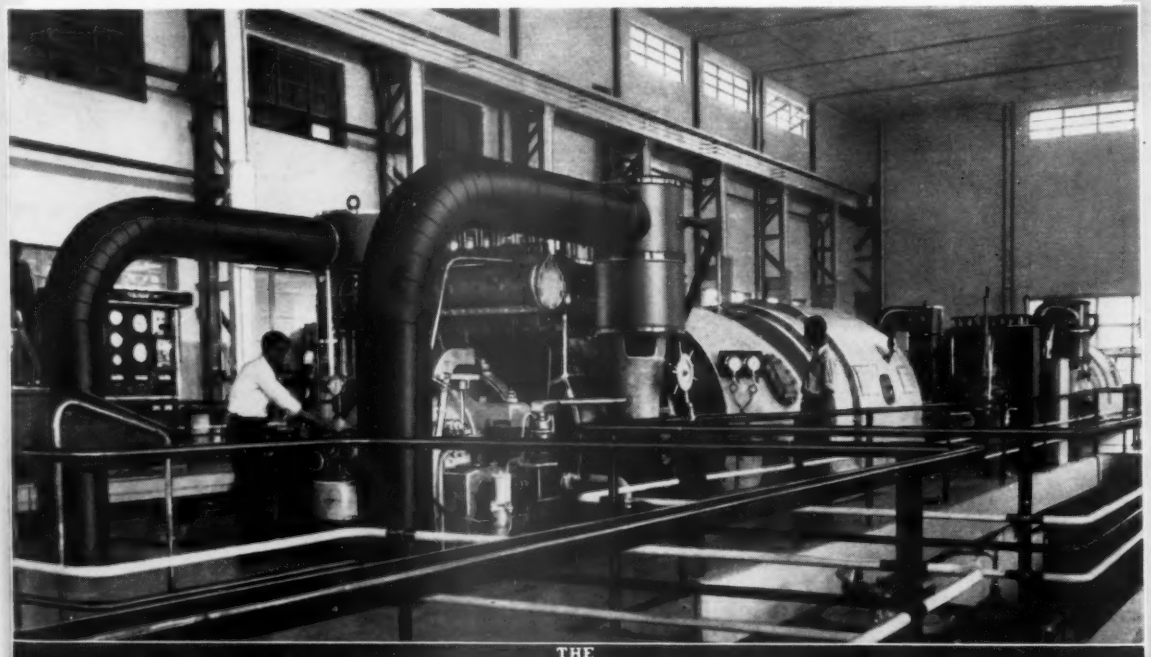

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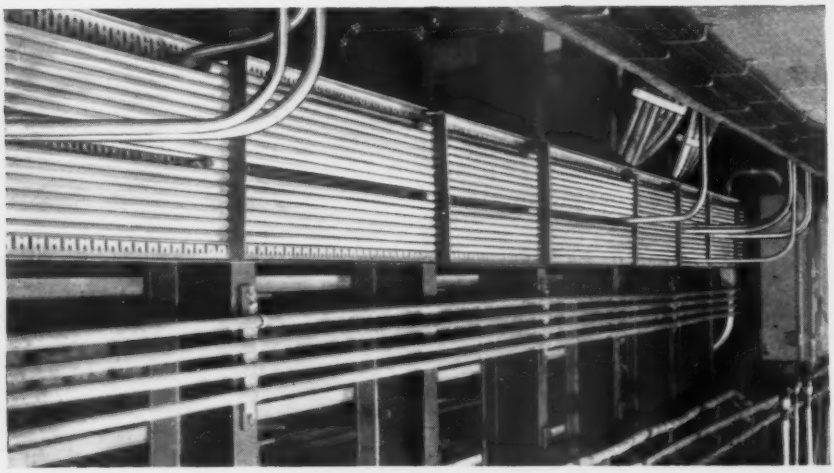

Photographs taken at Stourport 'B' Generating Station.

Consultants:
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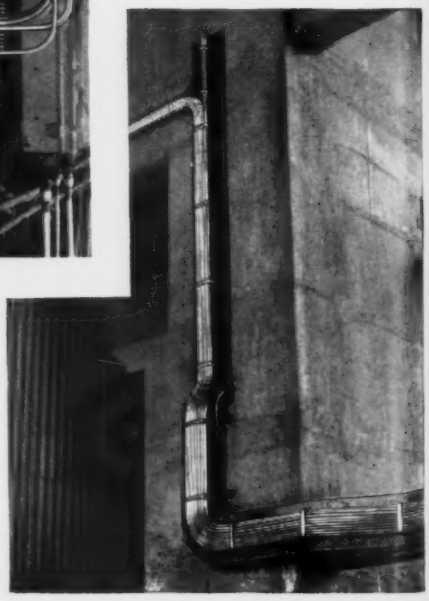

*Above:* A double bank of thirty J. & P. multi-core rubber insulated aluminium sheathed control cables.

*Right:* The ease of erection is well illustrated by this run of control cables mounted on perforated trays.

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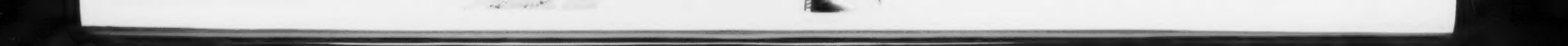

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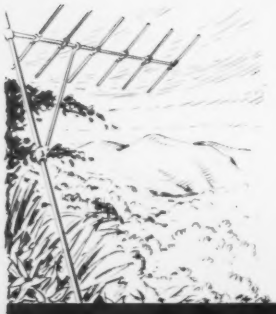

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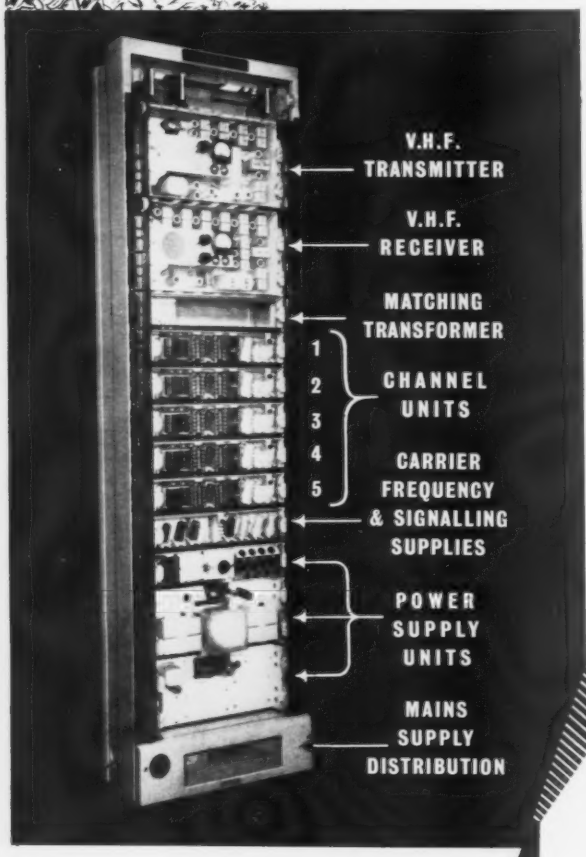

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# Wax—the most Versatile Product of the Oil Industry*

*By* C. F. McCUE, B.Sc.† *and* S. CURDS†

## Introduction

It has been said that wax can claim to be the most versatile product of the oil industry and this would be a difficult statement to challenge, for what other product is used in such diverse applications as bread-wrappings, beer-cans, shoe polish, candles, and cosmetics, to name only a few of the many uses of petroleum wax? Probably its nearest rival is that other fascinating thermoplastic, bitumen—but the utility of bitumen is limited by a sort of "colour-bar", its black colour making it unsuitable for many of the purposes in which pure white wax can be employed. The great variety of uses of these waxes is all the more remarkable in view of the fact that not so long ago they were regarded as waste products from the refining of lubricating oils.

Before embarking on a detailed consideration of the various applications, it would be as well to define exactly what these paraffin and microcrystalline waxes are and where they come from. If something is known of the processes involved in the manufacture of these waxes it is easier to appreciate how it is possible to vary the properties of the waxes produced and so make them more suitable for particular applications.

## Occurrence

Wax occurs in varying amounts in most crude oils but it is not always economically sound to extract it. The paraffin-base crudes (so called because they are rich in paraffin hydrocarbons) and the mixed base crudes (containing both paraffins and naphthenes) have the highest wax contents, but a crude containing more than 5 per cent wax would be considered extremely waxy.

The largest quantities of wax are produced in America but the Dutch East Indies, Burma, Assam, and Russia also have a considerable output. There is also a certain amount of paraffin wax obtained from British crude oil which happens to be fairly waxy.

The occurrence of paraffin wax is not confined to petroleum. In many parts of the world, including Scotland, it is extracted from oil produced by the destructive distillation of shale.

## Production of Paraffin Wax

The production of paraffin wax is, in the final analysis, simply a matter of separating the wax from the oil. The traditional method of doing this is in three stages:

(*a*) Concentration of the wax into one fraction by distillation.
(*b*) Precipitation of the wax by chilling, followed by filtration.
(*c*) Reduction of the oil content of the wax by a process known as sweating.

The "paraffin distillate" which is used as the feedstock for paraffin-wax manufacture is usually a cut taken between the gas oil and light lubricating oil fractions. It may contain as little as 5 per cent or as much as 30 per cent wax (but usually about 10 to 20 per cent), and is a slush at atmospheric temperature owing to partial precipitation of wax. At lower temperatures still more of the wax comes out of solution in the oil and this effect forms the basis of the next stage in the separation of wax and oil. The distillate is chilled to about 0° F (the actual temperature employed will depend on operating conditions), and the semi-solid mush is forced through a filter-press. The yellow or brown waxy material which collects on the filters is known as slack wax and still contains 25 to 50 per cent oil. Slack wax is used in fire-lighters and one or two other applications but for most purposes it needs to be further refined. The oily wax is melted and run into a large tank containing an array of closely-spaced water tubes. Cold water is passed through these tubes until the charge of slack wax has solidified and then the temperature of the water is slowly raised (usually about 1 to 3° F per hour). The result is a partial fractionation of the wax by melting. The constituents having the lowest melting points liquefy first and run out of the bottom of the tank. As the temperature rises, more of the wax is melted until eventually only the highest melting-point components are left. In this way it is possible to reduce the oil content and to separate the wax into fractions of different melting points. Fractionation is improved by carrying out the sweating operation in three or four stages and by using a rather complex scheme of recycling. The product obtained after one sweat is known as crude scale wax. It contains up to 5 per cent oil (usually 1 to 2 per cent), and after its colour and odour have been improved by treatment with bauxite, activated clay, or carbon it is widely used in the manufacture of candles, in waterproofing and in several other important applications. Fully refined paraffin wax usually contains less than 0.5 per cent oil and is also treated with some form of adsorbent before being moulded into slabs and packed in sacks or cartons.

## Production of Microcrystalline Waxes

Microcrystalline waxes are obtained from distillation residues (or sometimes from the material deposited on the bottom of crude oil tanks, "tank-bottom" waxes, or in wells, "sucker-rod" waxes). The wax is usually separated from the oil by means of a selective solvent such as methyl ethyl ketone in which the oil is quite soluble while the wax is virtually insoluble. The precipitated wax is separated by filtration or centrifuging which may, if necessary, be carried out at low temperature. By repeating this process it is possible to reduce the oil content to quite low values. It should be pointed out here that the sweating process is not applicable to microcrystalline wax. Owing to the very close structure of the wax the oil would not sweat from the wax, which would merely become softer as the temperature rose until the entire mass became fluid enough to flow from the sweater—there would be no separation of oil and wax components.

The wax is usually finished by percolation through an adsorbent to improve colour. For most applications amber or yellow waxes are adequate but for special purposes it is necessary to remove all colour. Decolorizing is an expensive process and therefore the pale and white waxes are much

* Paper read to the Northern Branch of the Institute, 16 November 1954.
† Esso Petroleum Co. Ltd.

more expensive than the dark waxes of the same melting point. An intermediate stage in the manufacture of microcrystalline wax is petroleum jelly or petrolatum. In its crude form this is usually almost black but the colour can be progressively removed to yield ultimately the pharmaceutical grades of yellow or white petroleum jelly. Petroleum jelly is, in effect, a mixture of microcrystalline wax and oil, and so corresponds to slack wax in the paraffin wax group.

The various steps employed in manufacturing the two types of wax are summarized in Fig. 1.

The solvent refining technique just described for microcrystalline wax is today quite widely used for paraffin wax production. In fact there are a vast number of variations, sometimes a sulphuric acid wash is introduced at some stage, sometimes the finished wax will be fractionated by distillation —the process being modified to suit the particular feedstock and the type of wax it is desired to produce. The description which has been given has deliberately been kept as simple as possible in order to emphasize the essential difference in origin of the two main types of wax: paraffin wax from a fairly close-cut distillation fraction, and microcrystalline wax from a heterogeneous residue.

## Properties

The source and method of production are, of course, reflected in the characteristics of the waxes produced. Chemically, paraffin wax consists almost entirely of a mixture of straight-chained or normal paraffins containing between 20 and 30 carbon atoms per molecule. The molecules of microcrystalline wax are usually larger and more complex; they contain 30 to 50 (or more) carbon atoms, many of which are arranged in branched chains. There is, however, an important group of high melting point microcrystalline waxes in which the degree of branching is only slight. This group has been given the name "petroleum ceresin" on account of the similarity to ceresin or refined ozokerite (a natural "earth wax" which is mined in Utah and parts of Central Europe). The petroleum ceresins are hard, brittle waxes capable of taking a high gloss, as opposed to the so-called "petrolatum" waxes which are softer, more flexible, and often quite tacky. The properties of the three main groups of petroleum waxes, paraffin, petrolatum, and ceresin are summarized in Table I.

TABLE I

PROPERTIES OF PETROLEUM WAXES

| *Characteristic* | *Refined Paraffin* | *Microcrystalline* | |
|---|---|---|---|
| | | *Petrolatum* | *Ceresin* |
| Melting point | 90–150° F | 140–180° F | 160–200° F |
| Colour | White | Dark brown to white | Dark brown to white |
| Oil content | less than 0.5% | 1–15% | Nil–5% |
| Viscosity at 210° F | 2.5–4 cs | 10–20 cs | 10–20 cs |
| Penetration at 77° F | 12–25 | 15–75 | 2–15 |
| Flexibility | Slight | Considerable | Slight |
| Tackiness | None | Slight to considerable | None |

## Marketing

Before discussing the various applications of these waxes, a brief mention may be made of the manner in which they are marketed. Paraffin wax is moulded into slabs, each weighing about 11 lb, which are packed in sacks so that each sack contains about 130 lb of wax. Microcrystalline wax is also moulded into slabs of about the same size but these are usually packed in cartons of about 80 lb. Paraffin wax is sold according to melting point (or more strictly—setting point); thus the term 125-130 paraffin wax means a wax which has a melting point between 125 and 130° F. The marketing of microcrystalline wax is not nearly so simple. Melting point is only one of the variables (and not always the most important). Other factors are colour, hardness, flexibility, and tackiness (not to mention special properties such as electrical characteristics which may be of importance for particular purposes). For this reason, these waxes are usually bought and sold by brand name. The customer finds a grade suitable for his particular purpose and relies on his supplier to maintain a consistent quality.

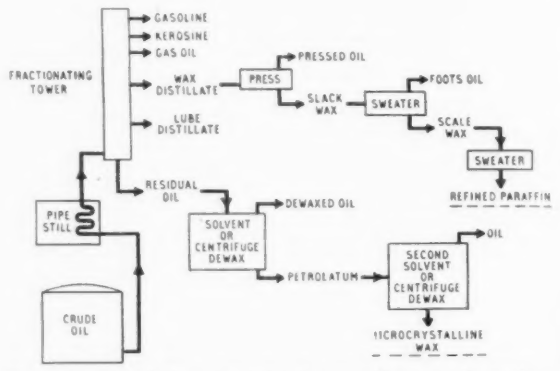



*Fig* 1. *Simplified flow chart for the manufacture of petroleum waxes.*

## Applications

The uses of petroleum waxes are so numerous that it is quite impossible to consider them all separately. It is possible, however, to deal with them under five or six broad headings with a rather more detailed consideration of the more important applications in each group. The classification has been based on the particular property of the wax which is mainly exploited (*e.g.*, inflammability, impermeability, thermoplasticity, etc.). Most applications, of course, take advantage of more than one property—in an article on paper packaging, T. C. G. Thorpe has listed twenty-one properties of which he considers fifteen are of various degrees of importance in that industry.*

### Inflammability

*Candles, tapers, matches, firelighters, flares, etc.*

Because solid wax melts readily to give an inflammable liquid it affords a very convenient and readily transportable source of light and heat. This is, in fact, its oldest and still one of its most important uses. For the less critical applications such as firelighters and flares slack wax can be used, but for matches, tapers, and candles it is necessary to use paraffin scale or even fully refined paraffin wax.

About 30 per cent of the paraffin wax and scale sold in the U.K. last year was for the making of tapers and candles. Although this *percentage* has been showing a steady decline in recent years (apart from a fillip during the last war and immediately afterwards owing to power cuts) the actual *amount* used remains fairly steady. It seems that despite increasing electrification there is still (and probably always will be) a demand for candles which cannot be met by other forms of illuminant.

Candles are, of course, much older than the oil industry. There is in the British Museum a bronze candelabrum 2500 years old. These early candles would have been made from natural waxes such as tallow or beeswax.

* Thorpe, T. C. G., *J. Inst. Petrol.* 1951, **37**, 275.

The ordinary household candle usually consists of paraffin scale to which has been added 2 to 3 per cent stearic acid. The stearic acid improves the appearance of the candle, makes it easier to remove from the mould, and helps to prevent the candle bending in warm climates.

There is a surprising demand for the old farthing dips which are used for lighting mines and other remote places. They are still made by successive dipping of the wick in molten wax (only the price has changed!). Eight or ten dips are required to build up a reasonable-sized candle. Certain special types of candles are also made by the dipping technique; in this way it is possible to use a wax of higher melting point for the outer coats so that a rim is formed as the candle burns—this prevents guttering.

Many large church candles are still made by the traditional method of suspending the wicks and pouring molten wax over them by hand. When a sufficient thickness has been built up the candles are rolled and polished. The Church of Rome requires that altar candles should contain at least 65 per cent beeswax.

Although recent developments in candle manufacture have not been spectacular it would be a mistake to assume that the industry is stagnating. Improved hardening agents such as hydroxystearic acid are being used and some manufacturers are adding small proportions of petroleum ceresin or even polyethylene to the mixture in order to improve the appearance and reduce any tendency to bending. It is also reported from the U.S.A. that poly*iso*butylene has been added to some night-light compositions in order to increase the viscosity of the molten wax and so prolong the time of burning.

**Impermeability**

*Waxing of paper, board, and canvas; coating of fruit and cheese; lining of cans and barrels; anti-corrosives, etc.*

The impermeability of petroleum waxes, particularly to water and water-vapour, makes them very suitable for a wide variety of applications from the coating of fruit and cheese to the protection of motor-car bodies. Not only is wax impermeable to water but it is also unaffected by mineral acids and alkalis and is therefore widely used for masking or "stopping-off" purposes in the plating industry or in the etching of glass. Undoubtedly its most important use is, however, in the treatment of paper and board for packaging purposes; this in fact accounts for about 50 per cent of the fully refined paraffin wax used in the U.K. at the present time (the corresponding figure for the U.S.A. is 70 per cent).

The use and evaluation of waxes for the packaging industry has been covered in some detail in the paper by Thorpe to which reference has been made. The subject will be only very briefly reviewed here and mention made of a few of the challenges which are presented to the wax producers. These will be considered under three headings: paper waxing, carton waxing, and laminating.

(*a*) **Paper Waxing**

Nearly all waxed paper is produced by a continuous process in which the paper "web" is fed through a bath of molten wax or over rollers which dip into the wax. Speeds range from 300 to over 1000 f.p.m. By a suitable choice of conditions the wax can be forced into the pores of the paper without leaving a waxy surface or it can be coated on one or both sides of the paper with or without impregnation. If the paper is required to resist the passage of moisture-vapour it must have a continuous film of wax on its surface. Moreover this film must remain continuous in use. If any rupture occurs, such as would be expected from bending or folding, the fibres of the paper underneath will be exposed to the air and their wicking action will soon transfer moisture-vapour through the sheet. So paper waxers require the wax to have a degree of flexibility. This would be easy to achieve if it were their only requirement. It is a fairly simple matter to produce a paraffin wax which is reasonably flexible in thin films. This can be done by leaving behind some of the low melting-point components which are usually removed in the refining process. This, however, gives a wax which softens well below its melting point. A roll of paper coated with such a wax would, in a very short time, "block", that is to say adjacent layers would weld together and the whole roll would become worthless. Then again, the paper waxers usually require the finished product to have a high gloss and this is difficult to achieve with a "wide cut" wax—glossiness tends to go hand in hand with brittleness.

So it will be seen that some degree of compromise is necessary in producing a wax to satisfy all the exacting demands of the paper trade. Usually it is possible to do this with straight paraffin wax but for special purposes some modification may be necessary. At this point a note of warning may be given to paper convertors. The relatively low price of paraffin wax is due to the fact that such a wide variety of industries are able to use the same product. If any one of those industries requires a different type of wax, or worse still several different types, then they must be prepared to pay the higher price which must inevitably result from the special processing, segregated storage, extra handling, etc. This may seem obvious, but many users do not appreciate the implications.

An example of a case where straight paraffin wax is sometimes inadequate is the packaging of frozen food. At really low temperatures any paraffin wax becomes quite brittle and so it is common practice to add a proportion of petrolatum wax when preparing paper for this application.

If the wax is required to have a hard, high-gloss finish 1 or 2 per cent of polyethylene or sometimes petroleum ceresin is added to the wax. Both these ingredients are rather expensive and costs are increased still further by the fact that the wax bath must be operated at a higher temperature. This in turn can give rise to trouble on account of oxidation of the wax unless a suitable anti-oxidant is incorporated in the blend.

(*b*) **Carton Waxing**

Cartons which are not required to be liquid-tight (*e.g.* butter and cheese packages) are usually waxed before assembly. The blanks are die-cut to shape and then fed on canvas belts through the wax bath; after surplus wax has been removed by squeeze-rollers the blanks are often dropped into cold water which gives the coating a glossy finish. When the carton is built up from the blank the wax coating is often required to serve as the sealing medium; this is achieved by local melting of the wax so as to obtain a weld. In other cases special adhesives are used.

This technique is obviously not suitable for cartons required to contain liquids because of the inevitable rupturing of the wax film which occurs at sharp corners. This difficulty is overcome by first making the carton and then dipping it in the molten wax. Typical of this type of container is the milk carton which is, perhaps, the most exacting use of petroleum wax. Milk is notorious for picking up foreign tastes or odours—so the wax employed must be completely tasteless and odourless. It must also be tough; that is to say it must be strong enough to impart rigidity to the carton but on no account must it be brittle so that the coating cracks when the carton is flexed (*e.g.* when the milk is placed —perhaps not too gently—on the doorstep). The addition of small proportions of petrolatum wax and synthetic resin can do a great deal to increase the toughness of paraffin wax.

(*c*) **Laminating**

Sometimes it is necessary to combine the properties of two or more films (*e.g.* the strength of paper with the

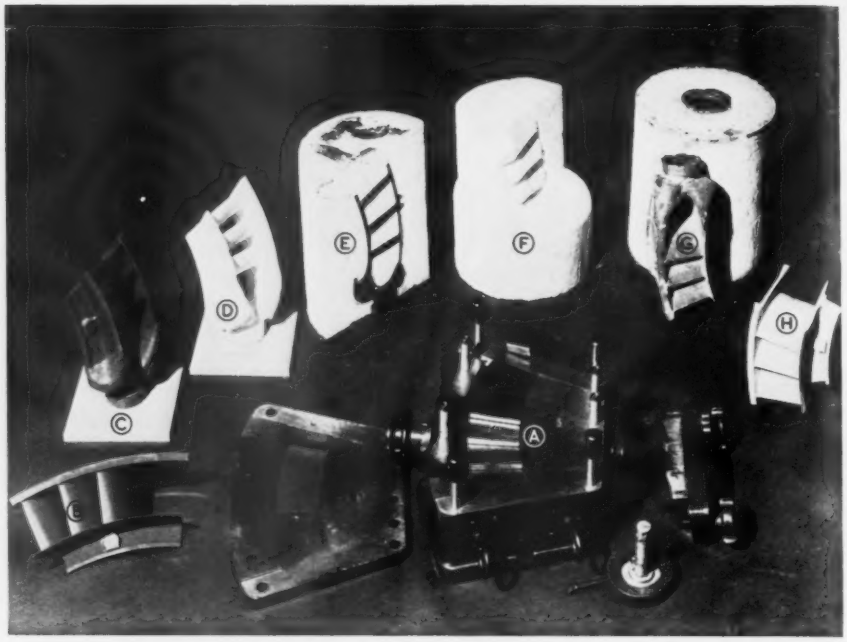



*Fig 2. The "lost wax" process.* (A) *Die.* (B) *Wax impression.* (C) *Impression mounted on wax riser.* (D) *Wax impression with primary coating prior to moulding.* (E) *Wax invested in mould.* (F) *Wax run out and mould fired.* (G) *Mould as cast.* (H) *Riser removed and casting fettled.* (*Photo by courtesy of the Bristol Aeroplane Co. Ltd., Engine Division.*)

impermeability and decorativeness of metal foil, as in tobacco wraps). This is often effected by means of a wax sandwich so that the wax film performs the dual function of adhesive and moisture-vapour barrier. The tackier varieties of petrolatum wax are usually employed for this purpose and if both of the sheets to be laminated are porous (*e.g.* paper) no additives are necessary. If, however, it is necessary to laminate non-porous films (*e.g.* metal foil or viscose film) it is usual to add a tackiness agent such as poly*iso*butylene.

**Thermoplasticity**

*Dental and modelling wax, investment coating of precision components, de-feathering poultry.*

Petroleum waxes are thermoplastic, that is to say when they are heated they melt, when they cool they solidify, and this process can be repeated almost indefinitely, providing temperatures are kept within limits, without any significant change in the nature of the wax itself. This property, coupled with the conveniently low temperatures at which the waxes melt, makes them eminently suitable for a variety of interesting applications. Most of us in our childhood played with modelling wax; this is essentially a low melting-point paraffin wax (say 110-115 English m.p.) suitably tinted with dye. In later life some of us have encountered a somewhat similar wax used by dentists when making dentures; dental wax is usually based on petrolatum wax to give flexibility, with the addition of resin for toughness. On a more technical plane, wax is also used for making models of, for example, the hulls of ships in order to study the effect of different designs on the way in which the boat will move through water. Such experiments are regularly conducted at the National Physical Laboratory.

A rather different use of wax as a thermoplastic is in the investment casting of precision components by what is known as the "lost wax" process. This process, which is widely used today for such work as the mass production of blades for gas turbines, is in fact a re-discovery of an art practised many centuries ago by the Chinese. Accurate replicas of the components are made by pouring molten wax into a suitably shaped mould. (See Fig. 2.) After the wax has solidified, the replicas are mounted on slender pedestals of the same type of wax and carefully "invested" or sprayed with a fine slurry of plaster-of-paris. An open-ended cylinder is placed over the replica and filled with more plaster-of-paris which is then allowed to set. The cylindrical block of plaster is heated in an oven until both the replica and its pedestal melt and run out of the bottom. Despite the name of the process the wax is not lost but is recovered and re-used. Any residual wax is burned off in an electric furnace leaving a perfectly clean accurate mould in which the component can be cast by pouring molten metal down the throat left by the wax pedestal on which the replica was mounted. After use the plaster mould is broken open and ground down for re-use. The cast component is dimensionally accurate and requires very little machining before use—this is important because the alloys used for turbine blades are extremely difficult to machine.

From turbine blades to poultry may seem a far cry but that is typical of the wide variety encountered in the petroleum wax field. The de-feathering of poultry by wax-dipping is another example of a modern adaptation of a very old technique. For centuries the Romanies have removed the quills of hedgehogs by rolling the unfortunate animal in clay and baking it over a fire; when the clay has hardened it is broken open revealing a cooked hedgehog minus its quills. The de-feathering of poultry is exactly the same in principle (except, of course, that the bird is not cooked). After the larger tail and wing feathers have been removed the bird is dipped in molten paraffin wax at a temperature a few degrees above the melting point (the 125 – 130 grade is usually preferred). It is then removed and allowed to cool so that a fairly thick uniform coating of wax forms over the whole bird. When the coating is cracked open it can be removed, usually in two or three sections, taking all the feathers with it and leaving the bird with an exceptionally fine appearance. Here again the wax is recoverable and efficient processes have been developed by means of which up to 90 per cent of the wax is made available for re-use. (See Fig. 3.)

As already stated, straight paraffin wax is usually adequate for this purpose but with difficult birds such as small pullets or ducks it is necessary to toughen the wax by the addition of suitable resins.

**Gloss**

*Polishes.*

The high gloss which is a characteristic of certain grades of petroleum wax makes them suitable ingredients for polishes. There are, of course, many different kinds of polish, each suited to a particular purpose. Perhaps the best known is the paste type of polish which is commonly used on floors, furniture, and footwear. Originally such polishes were based on natural waxes such as beeswax and carnauba plasticized with turpentine. More and more, however, these natural materials have been replaced or extended by petroleum products so that today many of the polishes on the market are virtually 100 per cent petroleum. Paraffin wax is extensively used (on account of its relatively low cost) but it suffers from two disadvantages. First, it has poor paste-forming properties, and secondly, the residual film of paraffin wax is too easily smeared. Other waxes must therefore be included in the blend. Certain grades of petroleum wax bear a striking physical resemblance to beeswax (and have, in fact, been marketed as "mineral beeswax"), and are also capable of forming excellent pastes with a suitable solvent such as white spirit. The desired hard high-gloss finish can be obtained by adding a proportion of petroleum ceresin which replaces the much more expensive carnauba.

Thus a well-balanced polish formulation includes all three of the main types of petroleum wax: paraffin, petrolatum, and ceresin. If a super-gloss polish is required this may be achieved by the addition of minor proportions of synthetic waxes or plastics such as polyethylene or, more recently, silicones.

**Electrical Insulation**

*Cables, radio components, etc.*

The excellent electrical properties of paraffin and the light-coloured microcrystalline waxes make them eminently suitable for the insulation of low-voltage cables, small transformers, coils, capacitors, and similar radio components. By virtue of their low viscosity when molten, complete impregnation can be obtained so that no voids are left. When solid, the wax not only acts as an insulator but is also its own moisture-proof barrier.

Perhaps the most critical application in this field is the coating of components for aircraft radio. For this purpose, in addition to being a good insulator, the wax must remain quite firm at temperatures approaching 200° F and yet must not become brittle at temperatures well below 0° F; it must also adhere tenaciously to the wire connexions so as to prevent the ingress of moisture at these points. All these requirements are usually met by blends of petrolatum wax and petroleum ceresin plasticized with polybutene, which also increases the adhesiveness of the blend.

**Miscellaneous**

So varied are the uses of petroleum wax that some of them defy all attempts at classification. Under this heading come such applications as rubber and leather, launching lubricants, and stationery (pencils, crayons, carbon papers, etc.)—in fact, it is literally a case of "shoes and ships and sealing wax". Special mention might be made of the use of waxes in the rubber industry as this illustrates a rather interesting difference in behaviour between paraffin and microcrystalline waxes. Most rubber mixes intended for moulding include a small proportion of wax. This not only plasticizes the mix and assists in the moulding operation but also slowly blooms to the surface and protects the rubber against "checking" or "crazing" (this crazing is mainly due to the action of sunlight and ozone). Paraffin wax blooms very quickly and so is effective for only a short period; micro-wax, on the other hand, hardly blooms at all. So the best sunproof waxes are a nice balance of paraffin and microcrystalline waxes which bloom at the required rate.

Esso photos

*Fig 3. Waxed and de-feathered.*

No account of the applications of wax would be complete without some mention of its pharmaceutical uses—not only in hospitals where wax baths are used for the treatment of chronic joint affections and where specimens are mounted in wax so that thin slices may be cut for inspection under the microscope, but also for its much more pleasant use in cosmetics. The most widely used petroleum product in this field is white petrolatum, but paraffin wax is often an ingredient of various types of cream, and white microcrystalline wax is used in lipstick formulations.

**Conclusion**

It is quite surprising how frequently one comes into contact with petroleum wax in everyday life. The average man pops downstairs first thing in the morning to make the early tea (using milk fresh from the waxed carton). Then, while his wife is making herself presentable with the aid of wax-based lipstick and cosmetics, he cleans the family shoes with wax-polish, at the same time listening to "Bright and Early" on the radio by courtesy of the wax insulation on the components. They then settle down to breakfast at which both the corn-flakes and the bread owe their freshness to their waxed wrappings. After breakfast he puts on his raincoat (proofed, of course, with wax) and goes to fetch the car, the tyres of which are still sound, thanks to the small proportion of wax in the rubber.

So through the day until after a hard day at the office he calls in at the "local" on the way home (whether he has his beer from a can or straight from the barrel it has not been in contact with either metal or wood but wax!). At home there is a nice roast chicken waiting for him; the bird looks all the better for being wax-plucked. After dinner he settles down to his favourite pipe with tobacco which has been kept moist for months by the foil and paper laminated with microcrystalline wax. Finally they light Junior's wax night-light and so to bed. Wax serves us in hundreds of ways—some quite unexpected—and its uses will continue to multiply. The word wax is not only a noun it is also a verb and in the dictionary its meaning is given—"to increase, to grow".

## CAPITAL CONTROL OF 1953 WORLD PRODUCTION

Details collected by the U.S. Bureau of Mines, compiled by F. X. Jordan, and relating to the capital control (by countries) of world oil production are published in the January 1955 issue of *World Petroleum Trade*.

In the accompanying table details have been extracted as regards area totals only, and percentages have been calculated and added. Compared with the figures for 1950-2 given on page 163 of our 1954 volume, no significant changes are noted.

CAPITAL CONTROL OF WORLD OIL PRODUCTION IN 1953

| | *Quantity in thousand brl.* | *Per-centage* |
|---|---|---|
| NORTH AMERICA: | | |
| United States | 2,298,964* | 90·6 |
| British and British–Dutch | 127,227 | 5·0 |
| Other private | 37,072* | 1·5 |
| Local government | 72,440 | 2·9 |
| | 2,535,703 | 100·0 |
| SOUTH AMERICA: | | |
| United States | 452,247 | 61·6 |
| British and British–Dutch | 240,889 | 32·8 |
| Other private | 1,604 | 0·2 |
| Local government | 39,246 | 5·4 |
| | 733,986 | 100·0 |
| EUROPE:† | | |
| United States | 5,425 | 1·2 |
| British and British–Dutch | 4,094 | 0·9 |
| Other private | 12,041† | 2·5 |
| U.S.S.R. | 444,000 | 94·5 |
| Local government | 4,463† | 0·9 |
| | 470,023‡ | 100·0 |
| ASIA: | | |
| United States | 569,162 | 56·1 |
| British and British–Dutch | 371,536 | 36·6 |
| Other private | 55,362 | 5·5 |
| U.S.S.R. | 7,000‡ | 0·7 |
| Local government | 10,979 | 1·1 |
| | 1,014,039 | 100·0 |
| AFRICA: | | |
| United States | 3,901 | 21·8 |
| British and British–Dutch | 12,600 | 70·4 |
| Other private | 1,402 | 7·8 |
| | 17,903 | 100·0 |
| OCEANIA: | | |
| Other private | 8 | — |
| WORLD TOTAL: | | |
| United States | 3,329,699 | 69·8 |
| British and British–Dutch | 756,346 | 15·9 |
| Other private | 107,489 | 2·3 |
| U.S.S.R. | 451,000 | 9·5 |
| Local government | 127,128 | 2·5 |
| | 4,771,662 | 100·0 |

*Includes estimate for Canada of 50,000,000 brl for U.S.A. and 30,402,000 brl for "other private" capital.

†Estimated in part.

‡U.S.S.R. in Asia (except Sakhalin) included with U.S.S.R. in Europe.

# Science Graduates

## Their Place in Education and Industry

In a speech delivered to the Chemical Society last month, F. A. C. Guepin, a managing director of the Royal Dutch/Shell Group of Oil Companies, spoke of the serious problem of the shortage of scientists both for teaching and for industry.

Mr Guepin said:

In our own business the ever-growing range of our activities both in the oil and chemical fields creates a need for steadily increasing numbers of scientists for research, applied technology and for field work, and in every phase of the business from the laboratory to the consumer.

If we want scientists, we have got to have science teachers. It is felt in some quarters that this lack of teachers, which will be at its worst for the next five years, may improve thereafter, but I am sceptical.

Industry is often accused of pinching potential science teachers and taking too much of the seed corn, but in this struggle for the men available, industry by no means leads the way. Universities, Government, and the Department of Scientific and Industrial Research all take their quota.

A recent estimation calculated that 60 per cent of the male Honours graduates in science and mathematics went to the schools and universities for teaching and research, whereas only 30 per cent went to industry and commerce, Government taking the remaining 10 per cent. Of Pass graduates 45 per cent went to the academic world, 40 per cent to industry and 15 per cent to Government.

The expansion in the oil and chemical business is likely to go on for many years to come with a correspondingly larger need for technical staff. What is to be done about it?

Firstly, there is a general need to make the best use of those scientists whom we already have. Secondly, we must increase the general flow, and thirdly, we must ensure that there is a proper division of the flow between teaching and industry.

Some of the questions we should ask ourselves are these:

> Are the Government, universities, and industry making the best use of those graduates who are now being taken or held? Of course, the universities should carry on fundamental research and must have their full share of Honours graduates. But are *all* those now kept on research there used to the country's best advantage, or should some of them be encouraged to go into industry?
>
> Is industry making full use of its graduates or could some of the work be done as well by those less highly academically qualified?
>
> Are we doing enough about the leak of boys who have had a good education up to the age of sixteen and who, perhaps with a technical bent, now go out to industry at that age to earn money there quickly rather than stay on and become fully qualified and of greater use to the country as a whole?
>
> Is enough done to make it easier financially for some at least to stay on the extra two years?

Perhaps more should be done to emphasize the prizes ahead for those who succeed in science and that no young man or woman need hesitate to take a technical degree.

Some of us reckon that there is a potential swing of some 10 per cent of boys in the so-called independent schools who, given the necessary encouragement, would go the science/technical route but who, thanks to long-standing tradition, are now encouraged to remain on the non-technical or Arts side. Here again something should be done to convince masters of the importance and security which the scientific field of employment offers. It may be that better equipment

*Continued on p. 120*

# India's Largest Refinery

Opened on 17 March by Dr S. Rodhakrishnan, Vice-President of India, the Trombay refinery of Burmah-Shell Refineries Ltd. is the largest refinery in India, with a crude oil intake of two million tons per year and an output of over 1,800,000 tons of refined products, exclusive of bitumen. Those present at the opening ceremony included Ministers and officials from the State and Central Governments, Sir Kenneth Harper, chairman of the Burmah Oil Company Ltd., and F. A. C. Guepin, a managing director of the Royal Dutch Shell Group.

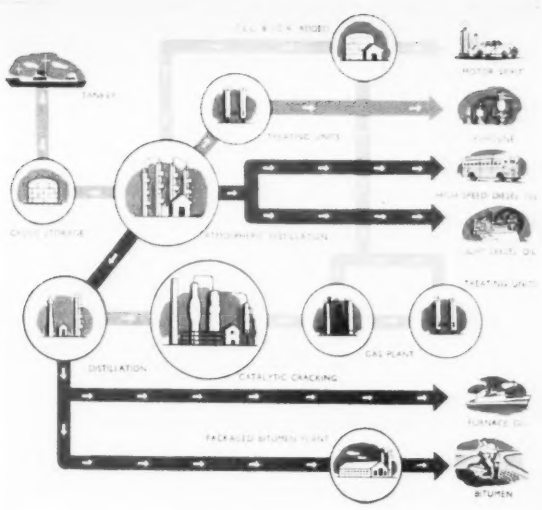
Located on Trombay Island, 10 miles north-east of Bombay, the refinery has been completed a year ahead of schedule. Work was started on site preparation early in 1953. Total cost of the refinery is over £23 million.

In the preliminary preparation of the 450-acre site two main obstacles had to be overcome. The first was that the Bombay Port Trust railway and also pipelines carrying Bombay's whole supply of white petroleum products ran through the site. Their removal without interrupting oil flow was accomplished in 50 working days at a cost of about Rs 13 lakhs.

The second obstacle was that a large part of the area consisted of salt pans below sea level and reclaiming was necessary. Eventual levelling of the site involved the shifting of some 600,000 tons of earth. For the movement of materials and workers it was necessary to build 12 miles of roadway within the site.

Materials used in construction included 60,000 tons of steel, 40,000 cubic yards of concrete, 200 miles of cable and wire, and 160 miles of pipe. In addition, a channel was laid for the return to the sea of the salt water needed for plant cooling and a special water main was laid for the supply of a million gallons per day of fresh water.

Labour force at the peak period numbered 14,000 and their work was not made easier by the two monsoon seasons during the construction period. In the 1954 monsoon 170 inches of rain fell on the site and special drainage facilities




were needed, as well as temporary protection for equipment already in position. Very wisely, the erection of large units and the heavier construction work were arranged to be completed before the monsoon in each year.

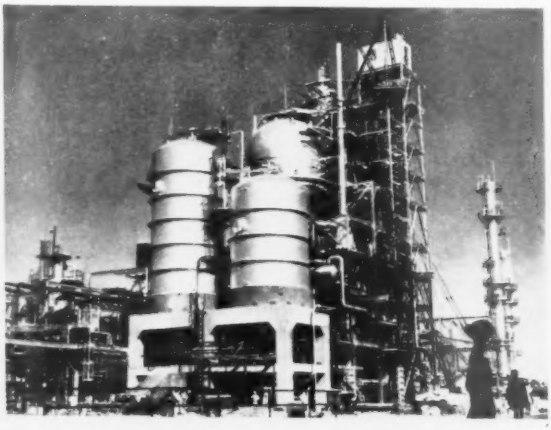
The largest individual piece of plant was the fractionating column for the cat cracker, and this weighed 110 tons. On arrival at Bombay, this column was off-loaded on to its transporter on a specially-fitted barge and the whole transported to Trombay by water. For handling this and similar heavy pieces of plant on the site a special derrick weighing 150 tons was brought from Curaçao.

For the reception of incoming tankers the Bombay Port Trust is building a marine oil terminal on Butcher Island. This will accommodate tankers of up to 30,000 tons capacity and is estimated to cost Rs 9·75 crores. From this terminal the crude will pass through submarine pipelines to the mainland and thence to Trombay for storage before treatment. Pending completion of this project, a buoy mooring berth and a temporary under-water pipeline are being used.

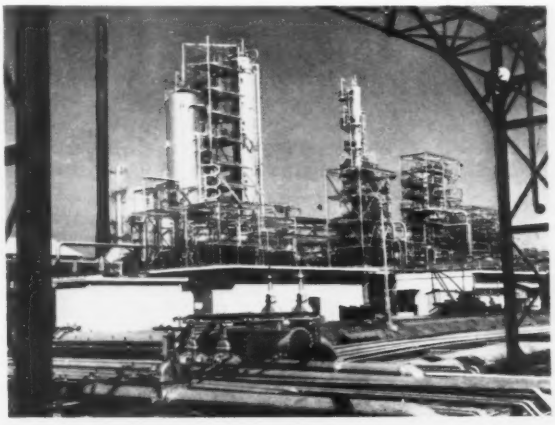
As will be seen from the accompanying diagram, the design of the refinery follows conventional modern practice. The crude is first subjected to atmospheric distillation to give four main cuts, the first three being treated to yield motor spirit, kerosine, and two grades of diesel oil. The fourth

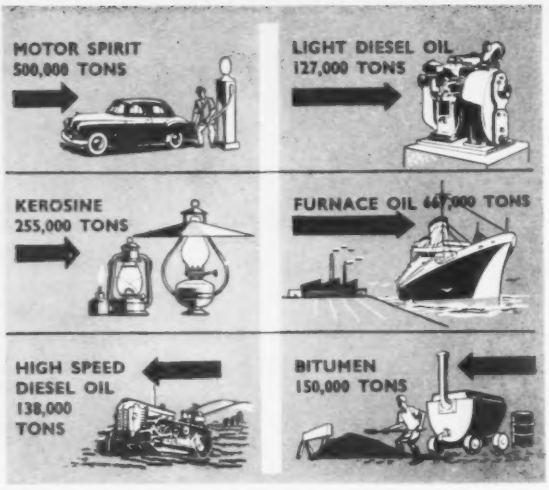
*A close-up of the catalytic cracking unit.*

Shell photos



*The crude distillation unit (left) and the feed preparation unit (right).*






residual cut is further distilled to produce a feed for the catalytic cracking unit, a furnace oil, and bitumen.

Total output of the refined products is estimated as shown pictorially in the second diagram. It is anticipated that this refinery, together with the Digboi refinery of the Assam Oil Company now being enlarged, and the new Stanvac and Caltex refineries, will be capable of supplying India's internal needs for motor spirit and fuel oil as well as a large proportion of her other petroleum needs.

A well-equipped testing laboratory has been provided and is run almost entirely by Indian personnel. To provide staff for higher technical posts, 29 Indian trainees first received preliminary instruction at Digboi and then spent nine months in Shell refineries in the U.K. and Europe. A further 20 received practical training on the site as construction proceeded. The 200 Indians who will operate the units have also been instructed in up-to-date technique.

A modern two-storey canteen and a well-equipped medical centre have been built and the Company has contributed £300,000 towards the cost of housing about 500 workers and their families near the site.

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# Trade Literature

### New Electric Fork Truck

Wessex Industries (Poole) Ltd. have recently introduced a modified version of their E.650 electric-battery-operated driver-controlled fork truck. In the new model the load rating has been increased to 1250 lb at 15-inch load centres, lifting to a height of 7 ft 6 in.

### Atomic Models

Courtauld atomic models for use in research and education are described and illustrated in a leaflet, GT1465, prepared by the manufacturers, Griffin and Tatlock.

The models are made on the scale 0.8 inch = 1 Ångstrom. They have been designed to allow elastically-distortable valency angles, free rotation about single bonds, and the use of bonds of adjustable length.

### British Instrument Industries Exhibition

A full range of instrumentation equipment for the measurement and control of flow, temperature, and pressure of air, gas, steam, and liquids, and liquid levels, is to be shown by Eyershed and Vignoles Ltd. at the British Instrument Industries Exhibition.

### Exhibits at the B.I.F.

Stainless steel distillation equipment for the oil refinery and chemical industries will be shown at the British Industries Fair at Castle Bromwich this year by Metal Propellers Ltd. of Croydon. Two designs of Glitsch "Truss-type" bubble tray will be among the products on display.

### Physical Society Exhibition

Instruments and apparatus of interest to the petroleum industry were among the exhibits displayed at the Physical Society Exhibition in London last month.

A number of exhibits were shown by Griffin and George Ltd., among them the Nivoc spectrometer and vapour phase chromatographic analysis apparatus.

Products shown by W. Edwards and Co. (London) Ltd. included rotary gas-ballast pumps and new types of vapour diffusion pumps. Another exhibit by this firm was a gas-flow-operated safety switch.

Hilger and Watts Ltd. displayed among their exhibits new arc and spark stands for spectrochemical analysis, a recording infra-red spectrophotometer, and a photo-electric Tristimulus colorimeter.

Variable-inductance pressure transducers and a range of pressure gauges were among the products shown by Kelvin and Hughes Ltd. and the Baird and Tatlock (London) display included a firing unit with self-contained testing circuits for bomb calorimeters.

### Welding Aluminium

Information on modern methods of welding aluminium and its alloys is contained in an illustrated booklet published by the Northern Aluminium Co. Ltd. of Banbury, Oxfordshire.

Details are given of the argon tungsten arc and inert metal arc processes together with data on suitable alloys and on weld strength.

*This mobile exhibition van is used by Newman, Hender and Co. Ltd. of Woodchester, Stroud, to display their range of valves and fittings. The 21-ft-long trailer is now touring England with a general range of the company's products but it is later to be revised to present a range of valves and fittings for the petroleum and chemical industries.*

# Around the Branches

BAHRAIN, FAWLEY, KUWAIT, LONDON, NORTHERN, SCOTTISH, SOUTH-EASTERN, SOUTH WALES, STANLOW, TRINIDAD

### Bahrain Branch

**First Ordinary Meeting**

On the evening of 6 February, 120 members and guests attended the first ordinary general meeting of the Branch.

After the preliminary business had been concluded, A. H. R. Grimsey, fields manager of the Qatar Petroleum Co., took over from the chairman and conducted a symposium, entitled "Operations of the Qatar Petroleum Company". Mr Grimsey introduced the speakers, the first of whom was W. G. Crafer, personnel manager, who gave a general picture of the State of Qatar, its history and peoples, and spoke of the enormous difficulties arising from the very meagre natural supply of drinking water in Qatar. These difficulties were, he said, slowly being overcome by the installation of water distillation plants using sea-water.

P. J. Walmsley then showed a number of slides showing various aspects of life in Qatar and some of the operations of the Qatar Petroleum Company.

Next, A. R. Gardiner and S. B. Ford spoke of drilling and production practices respectively. Mr Gardiner outlined the steps involved in drilling an oil well to a depth of 6000 ft, with references to the geological formations encountered and to the drilling fluid, casing programme, and completion methods. Mr Ford described the production operations of the Qatar Field and dealt in particular with the setting up of three de-gassing stations for treating the crude before pumping it to Umm Said.

Finally, Mr Grimsey gave a résumé of the supporting services in Qatar and dealt in some detail with the new camp at Umm Said to which the administrative offices and stores are to be transferred from Dukhan.

**Fire at Dukhan**

After an interval during which members were able to look at a display of photographs illustrating the activities of the Qatar Petroleum Company, the inaugural meeting was brought to a close with the showing of the film, *Fire at Dukhan* —a record of the fire at Dukhan Well No. 35 in April 1953. The film showed in detail the steps taken by a fire-fighting expert to control the fire, to put it out, and finally to cap the well and place it on production.

The meeting ended with a vote of thanks to the speakers from Qatar proposed by G. Beeby-Thompson.

### Kuwait Branch

Officers for the session 1955-56, elected at a committee meeting on 23 March, are: *Chairman*—J. M. Dougary; *Hon. Secretary*—J. G. Cooper; *Hon. Treasurer*—J. Rae; *Meetings Secretary*—E. J. Sole.

### South Wales Branch

A meeting was held at the Training Centre, National Oil Refineries Ltd., on 3 March, under the chairmanship of J. A. Green, to hear J. Tyers (Technical Services Branch, British Petroleum Company) give a talk on "Development in the Use of Fuel Oil in Industry".

Referring to the world-wide importance of the use of fuel oil, Mr Tyers drew on his own experience in many countries and discussed the reasons for the present trend in the use of fuel oil—the postwar urge towards combustion efficiency, the need for reduction of atmospheric pollution, and the increasing cost of coal. Fuel oil could not, of course, replace coal, said Mr Tyers, but was a supplementary or alternative fuel.

The first major use of fuel oil was for steam raising, a change from coal to oil in many cases showing increases in efficiency from 50 to 70 per cent. There were, however, problems associated with the change—such as superheating difficulties and sulphur content. Slides illustrating how these problems are being attacked were shown and it was demonstrated that acid deposition is not dependent on the level of sulphur in the fuel oil.

Mr Tyers then discussed the use of additives for the prevention of smoke, sludge, and emulsions.

The second major application for fuel oils was in the steel industry, said Mr Tyers, the problems here being sulphur, emissivity, and cost. The use of fuel oil had, however, increased the efficiency of the furnaces.

The third major use was in the cement industry where cost was an important factor. Mr Tyers discussed the desirable type of flame and the use of a hose-type burner to produce this, and said that refractory life was also a major consideration.

The fourth major use was in the gas industry where the conventional material for gas carburetting was obtained from the cracking of gas oil. Experiments were now proceeding with heavy fuel oil and crude oil.

Finally, Mr Tyers spoke of the successful use of fuel oil in the coking industry, with specially interesting reference to its help in the production of metallurgical coke.

After an interesting discussion of questions from the audience, Dr Thornes proposed a vote of thanks to the speaker.

### Stanlow Branch

A joint meeting of the Branch with the Institute of Fuel, North Western Section, was held at the Grosvenor Hotel, Chester, on 16 February.

A lecture entitled "Relations between the Petroleum Industry and Government" was given by J. A. Beckett of the Ministry of Fuel and Power. Mr Beckett was for some years chairman of the OEEC Oil Committee in Paris and Petroleum Attaché in Washington.

The lecturer pointed out that the function of the Ministry was "co-operation rather than control" and went on to illustrate this by mentioning the Abadan negotiations, and the close and friendly relations between the Ministry and the oil companies.

Mr Beckett explained that the Ministry of Fuel and Power was a comparatively new body which had been set up in 1942 and received its Charter in 1945, and he went on to outline its operational organization and day to day duties.

There was no equivalent Government body in the U.S.A. but a Petroleum Attaché was maintained by the U.K. in Washington to act as liaison in all oil matters.

Where European contacts were concerned these were maintained through the OEEC Oil Committee and for other countries through the ambassadors.

The lecturer summed up by pointing out, once again, the absolute minimum of statutory control by the Ministry and the good relations that existed between all concerned.

The discussion which followed was opened by Mr A. Cluer of Lobitos Oilfields Ltd., and Mr Harrison-Slade, Chairman of the North Western Branch of the Institute of Fuel, proposed the vote of thanks.

### Trinidad Branch

The 27th Annual Meeting of the Branch was held on 28 January 1955. Commenting on the Report for the year,

the outgoing Branch Chairman, Dr A. L. Down, stated that the Committee had maintained the high level of activity set during the previous year. Membership showed a small decrease due to members leaving the Colony but the number of applications for membership was satisfactory.

In this connexion the Chairman touched on the subject of the introduction of non-corporate membership, and later in the meeting he enlarged upon the significance of such a step being taken by the Branch. The matter was put to the meeting, and the majority appeared favourable towards non-corporate membership.

Dr Down mentioned that the Annual Dinner had been held very successfully at the Trinidad Country Club. He expressed thanks to members of the Committee for their co-operation and help during the year and referred particularly to the work done by E. Everett as Honorary Secretary.

Two films, *It Never Rains Oil* and *Rig* 20 were then shown. They were followed by an interesting commentary by E. Shaw, who was present at Rig 20 during the fire, and a lively discussion ensued during which Mr Shaw answered a great many questions.

**Residue Logging**

A general meeting of the Branch was held at the Apex Club on 25 February 1955. Dr A. L. Down presided, the Branch Chairman Mr J. Hulme being unfortunately indisposed.

The subject of the evening was a paper on "The Practice of Residue Logging" read by Dr W. L. Buning, chief palaeontologist of The United British Oilfields of Trinidad.

Dr Buning explained that the principle of the method is based on:

(*a*) the fact that the quantity of loose grains present in a standard volume of unconsolidated rock and screened off by a fine sieve varies with any change from clay into sand; and

(*b*) the assumption that an uninterrupted series of samples collected at close intervals from the mudstream in a drilling well should reflect all changes in the formational characteristics.

A fast, fairly simple, and inexpensive procedure to follow closely the lithological changes in a well during drilling operation has been worked out by the author since 1953. The method is based on a graphical representation of the amount of residue left by washing a standard volume of screen sample through 40-, 100-, and 200-mesh sieves. These three figures are plotted one after the other in a way, and on a scale, which makes the graph easily comparable with the electric log.

It appears that only a small percentage of the real sand content of sand layers penetrated by the bit is recorded on the residue log owing to dispersion of part of the incoherent rock cuttings in the mudstream.

Nevertheless, it is found that where sands are developed between shale intervals their presence will in general be clearly indicated on the residue log. In cases where the desirability is felt for more subsurface information than is ordinarily obtainable, the availability of a residue log is a valuable aid during the time interval from spudding-in till the Schlumberger diagram is at one's disposal. In the meanwhile correlation may have already been possible with neighbouring wells, making the decision whether to stop or continue drilling easier. Furthermore, if water base mud is used, the timely reporting of the presence (or absence) of oil in certain beds may prove of actual importance under certain circumstances.

It is obvious that success of the method depends principally on the quality of the cuttings reaching the surface. It has been found, in practice, that depth lag and cuttings do not seriously affect the residue log; however, contamination of the shaker-samples is strongly increased by a drop in drilling rate. Slow speed of penetration due to depth and or hard formation may render the samples collected from the mudflow completely unrepresentative for the formation at the bit, and consequently worthless for any study. It would seem that the use of oil-base mud is an advantage in that contamination of shaker-samples is reduced to a much greater extent than with ordinary drilling mud.

The lack of accuracy and detail in logs, based on screen samples, is compensated by the fact that the graphs can provide almost up to the minute information about layers penetrated. Furthermore, residue logs may serve as the nearest substitute for a Schlumberger diagram in case of technical failure to procure the latter.

A very lively discussion was opened by Dr Kugler, who regretted that, due to the development of electric logging, much useful information had been lost because the old form of residue logging had been largely abandoned.

A vote of thanks to Dr Buning was proposed by Mr Godfrey and was heartily endorsed by the members and guests present.

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## COUNCIL COMMENTARY

At the meeting of Council held on 13 April, many of the subjects for discussion were of general and current interest to all members of the Institute. As regards the World Petroleum Congress, it is necessary to nominate British delegates to the Permanent Council of the Congress and it was agreed that the President, Mr Gibson, and Dr E. B. Evans should undertake the necessary duties. Incidentally, grateful acknowledgment of Mr T. Dewhurst's past activities in this direction was recorded.

The result of the 1955 Council Ballot will, of course, be announced later. This particular ballot was considered notable because of the unusually large number of votes which had been recorded, particularly from overseas sources. It was recommended that the following members should be nominated by Council to fill the six *ex officio* vacancies on Council for the year 1955-6.

| | |
|---|---|
| S. M. Berridge. . . | Fawley Branch |
| W. H. Davies . . . | London Branch |
| A. S. Brooman. . . | Stanlow Branch |
| W. M. Sterling . . | Scottish Branch |
| J. R. Moore . . | South Eastern Branch |
| G. M. Davies. . . | Northern Branch |

The report of the Branches Committee showed that these organizations were all in a very flourishing condition and it was observed that the Persian Gulf Branch had now been replaced by two Branches, one at Kuwait and the other at Bahrain. The suggestion that a Canadian Branch should be formed was received enthusiastically and steps will be taken to ascertain the feasibility of such a move.

As regards the nominations for Council committee-chairmen for 1955-6 there was only one change and that was with respect to the Education Committee. J. A. Oriel asked to be relieved of his responsibilities in this connexion owing to activities relating to his forthcoming presidency of the Institution of Chemical Engineers. It was suggested that Dr C. G. Williams should act as Chairman in his place.

In presenting the report of the Publications Committee, Dr E. B. Evans, its Chairman, announced that the 1956 Summer Meeting would be held at Torquay and that the theme of the meeting would be "Essential Factors in Future Development of the Oil Industry". This theme would be developed on the basis of approximately eight papers.

# Books and Films

### "Oil of Iraq"

It is the peculiar merit of the Iraq Petroleum Company's Film Unit that it has the imagination to produce films which hold the eager interest of both Arabs and non-Arabs. The latest production of this Unit, *Oil of Iraq*, was shown recently to an invited audience in London, and the opinion was generally expressed that while the reaction of an English-speaking audience was enthusiastic, the film in its Arabic version would not only inform Arabs on the industry which is Iraq's chief source of wealth but would also make them proud of their countrymen's part in a great undertaking.

By natural stages of progression, *Oil of Iraq* shows that the discovery of oil in Iraq, whether it be in hills or plains or marshes, is frequently made only after years of geological and geophysical investigation, that drilling, chemical examination, de-gassing, and stabilization of crude oil demand the highest degree of skill and knowledge, and, incidentally, that the whole process may involve the expenditure of millions of pounds before a penny is received by the concessionary company.

Only the outlines of a complicated business can be shown in such a film as this, but the choice of subjects has been so carefully made that a novice can understand them. The preliminary examination of the sub-surface soil, the choosing of sites for wells, the stages of drilling, the erection of de-gassing stations, and the machinery and processes which are required before the crude can be sent along its way by pipelines either to the Mediterranean or the Persian Gulf—these are depicted in the most vivid way. The film, in short, is highly educative, and the petroleum industry as a whole is indebted to the I.P.C. Film Unit.

But *Oil of Iraq* is not primarily technological—not even "technology without tears". It is the story of the mobilization of the resources of skill and material which is necessary not only that Iraq's potential oil wealth may be realized, but also that through her own Development Board it may be re-invested in projects which will increase the fertility of the soil and enrich the lives of her people.

Apart, however, from its message, the film, with its superb colour photography, has first-class value as entertainment, and it is difficult to believe that it will not be cordially received by all Arabs who see it (a number which may be three-fifths of Iraq's population of 5,000,000). It is good, moreover, to see that some of the Iraqis trained by the I.P.C. Film Unit have played a considerable part in the making of *Oil of Iraq*. Such training is the set policy of this Film Unit, and its results are already bearing fruit.

This film is in Eastmancolour (16 mm and 35 mm), and is obtainable on loan from Petroleum Films Bureau, 29 New Bond Street, London, W.1.

### Owen Organization Film Unit

Films produced by the Film Unit of the Owen Organization are available on loan to companies, societies, and clubs. The films are all 16 mm in size and can be shown in the Organization's own cinema if desired.

Two films recently released by the Organization are *An Industrial Commonwealth*, a thirty-minute film in colour covering the activities of the Owen Organization as a whole, and B.R.M. 1954, a twenty-minute film, also in colour, showing the new Mark II B.R.M. and many of the season's races.

Separate films deal with the career of the B.R.M. in the years 1951, 1952, and 1953.

Other films show the work of various companies, for example, *For Every Vehicle* deals with the work done by Rubery, Owen and Co. Ltd. in the making of components for the motor industry, and the manufacture and use of fork lift trucks is shown in a film made for Conveyancer Fork Trucks Ltd. entitled *Fork Lightening*.

The manufacture of agricultural machinery and equipment is illustrated in a series of films made for Salopian Engineers Ltd., and an interesting training film is available, entitled *A Subject for Discussion*. This shows a panel of supervisors from leading firms discussing the industrial problems of today and is recommended for discussion groups.

Enquiries with regard to these films should be addressed to The Public Relations Office of the Owen Organization, Kent House, Market Place, London, W.1.

### "Fuel Oil"

The economics of oil firing, various types of oil-burning equipment, and the applications of oil-firing, are illustrated and discussed in *Fuel Oil*, a new film produced by the Esso Petroleum Company.

This is a semi-technical film in which the problems are presented in simple terms. It will be of great assistance to those who are considering the virtues of oil as a replacement for coal in the firing of boilers and furnaces for industrial and institutional purposes.

Copies of this 16-mm film are available free on loan from the Industrial Sales Department of Esso Petroleum Company Ltd., 36 Queen Anne's Gate, London, S.W.1, or from divisional offices of the Company.

### Lubrication Methods

Subtitled "A summary of thirty years specialized research into the selection, design, and application of lubricating equipment in the machine age", Messrs Tecalemit Ltd. have recently issued an informative and attractive quarto-size loose-leaf book under the title of "Modern Methods of Lubrication".

This book is divided into eleven sections, the first seven of which concern Tecalemit lubrication equipment. Thus, Sections 1 to 3 deal respectively with manual, automatic, and intermittent grease lubrication, Section 4 with general applications of oil and grease, Sections 5 and 6 with automatic and intermittent oil lubrication, and Section 7 with continuous oil circulation. This sub-division should facilitate the task of the engineer in selecting the right type of equipment for his purpose.

The remaining four Sections are devoted to various other products related to lubrication, such as bulk storage and dispensing, filtration, pipework and fittings, and ancillary equipment. Useful tables are appended.

As a book of reference "Modern Methods" is unique in the field and the Company are making a limited number available for purchase at 25*s*. 0*d*. per copy. These are obtainable on request from Tecalemit Ltd., Plymouth, Devon. The book will be kept up-to-date by the issue of new leaves as necessary.

### French Petroleum Equipment

Founded less than two years ago, the Association of French Manufacturers of Equipment for the Petroleum Industry (Groupement Intersyndical des Fournisseurs de Matériels d'Equipement pour l'Industrie du Pétrole) has recently published the first issue of its official catalogue. This catalogue in 400 pages gives displayed announcements from the 225 suppliers and contractors who are its members. Preceding this section of the book is a complete list of the members and the products which they manufacture, and a classified list of the various types of equipment with a note of the French manufacturers and the page of the catalogue on which their announcement will be found. This classified index is rendered

more useful by the fact that the English equivalent is given for each piece of equipment. There is also a list of trade names and a dictionary of English terms, arranged alphabetically, and their French equivalents. The price of this catalogue is 2500 francs and it is published by La Revue Française de l'Energie, 3 rue Soufflot, Paris 5e.

### "Materials Handling News"

A new quarterly publication, "Materials Handling News", is to be produced by Associated Iliffe Press in an attempt to reach firms which are not making the maximum use of mechanical handling equipment. The first issue will appear on 1 July and copies will be distributed free.

Regular large-scale users of this equipment are already catered for by a parent journal, "Mechanical Handling".

### Who's Who in the Motor Industry

The second edition of this guide to the motor industry of Great Britain is a veritable mine of information on the subject of personnel, firms, and associations connected with that industry. It must, therefore, be of considerable value to the petroleum industry, for its 880 pages contain details of the activities and personnel of over 2000 firms, detailed biographies of 3250 persons engaged in the industry and many of whom are also well-known in the petroleum industry, information regarding 89 trade and professional associations, and particulars of the press coverage for the industry.

Although only in its second edition, the first having appeared in 1952 with a supplement in 1953, this work is already a standard work of reference and the price of 27*s.* 6*d.* is very reasonable for a publication of this type. It is published by Roland C. Bellamy Publications, Saint Mary's Gate, Grimsby, Lincolnshire.

### "Evershed News"

"Evershed News", published by Evershed and Vignoles Ltd. since February 1953, has recently undergone a change of character.

Formerly a house journal containing short items of news about Evershed products and personnel, it now contains articles of more general interest to the electrical, instrument, and instrumentation industries, and gives details of latest developments in instruments.

"Evershed News" is to be published six times yearly and will be sent to anyone who is interested in the industries it covers.

### "1954 Achievements"

Highlights of motor sport during 1954 are presented in a vividly illustrated booklet published recently by C. C. Wakefield and Company Ltd.

Events all over the world and every aspect of motor and motor-cycle racing are covered, with notes on the personalities, vehicles, and circuits.

### "Petrolieri d'Italia"

A new magazine was added to the petroleum literature of Italy in December 1954 when the first issue of "Petrolieri d'Italia" was published. The new publication is an illustrated review covering every aspect of the Italian petroleum industry.

### British Petroleum Equipment

The 1955 56 edition of British Petroleum Equipment, the composite catalogue of British-manufactured oilfield equipment issued by The Council of British Manufacturers of Petroleum Equipment, is scheduled for publication this month.

This is the fifth edition and the catalogue will contain 770 pages of information, 88 pages of classified equipment made by members of the CBMPE and the remainder comprised of entries compiled by individual members.

The price is £2 10*s.* and copies will be available from the Council's offices at 79 Buckingham Palace Road, London, S.W.1.

### Corrosion Prevention

The British Iron and Steel Research Association (BISRA) has recently published a short monograph on the subject of the prevention of corrosion. The booklet deals with causes and inhibition of corrosion and discusses the subject under the three main headings of corrosion in air, in water, and in the soil.

Dealing with water corrosion two aspects of the subject are considered, that is ship structure and shore installations, and the value of metal coating and cathodic protection are also discussed. In dealing with soil corrosion the differences in protective coatings are discussed in detail and the use of blown bitumen as an inhibiting agent is specially referred to.

The book is obtainable from BISRA, 11 Park Lane, London, W.1., the price being 2*s.* with 25 per cent discount on bulk orders for 50 to 100 copies.

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## OIL FUEL IN THE STEEL INDUSTRY

Writing in the recent (28 February) survey on steel, published in *The Financial Times*, E. Julian Pode, managing director of The Steel Company of Wales, said:

"The use of liquid and gaseous fuels has shown a considerably greater increase than the expansion of the steel ingot output, which illustrates the fact that the use of coal for miscellaneous purposes has tended to be supplanted by the use of liquid fuels and gas. The greatest change has occurred in the open hearth furnaces where fuel oil, other liquid fuels, and coke oven gas are tending to supplant the use of gas producer coal.

"The use of fuel oil has made rapid strides, particularly in districts where the availability of good quality gas producer fuel has become restricted, but there is a wider question than this—namely, the technical advantages of fuel oil—furnace operators are able to pump more heat into the furnace, and have also more positive control. Further, with the advent of the continuous working week, fuel oil does not present the difficulty of flue cleaning, which was present in the older practice. Ultimately, however, the choice of an open hearth furnace fuel must rest on economics. The available therms in fuel oil are more expensive than those in producer coal. Therefore, economies in operation and additional output must be achieved to make this practice profitable. Another limiting factor in the more extensive use of fuel oil is the fact that a large proportion of the fuel oil available to the United Kingdom has a sulphur content which militates against its use in the open hearth furnace due to the fact that the steel in the bath of furnaces picks up this deleterious substance."

The following statistics are extracted from a table covering the years 1948-1954:

| | 1948 | 1951 | 1954 |
|---|---|---|---|
| Steel ingot output (1000 tons) | 14,876·6 | 15,638·5 | 18,520·0 |
| Fuel oil used (1000 tons) | 737·6 | 833·6 | 1,174·3 |
| Tar used (1000 tons) | 49·5 | 135·3 | 196·0 |
| Creosote pitch used (1000 tons) | 96·8 | 175·1 | 302·4 |
| Gas and diesel oils used (1000 tons) | 4·6 | 8·7 | 32·7 |
| Coke consumed (other than coking) (1000 tons) | 7,818·1 | 7,340·9 | 5,984·2 |
| Coke oven gas used in steelworks (m.cu.ft.) (est.) | 48,830 | 58,242 | 80,000 |

# The Outlook for U.K. Energy Needs*

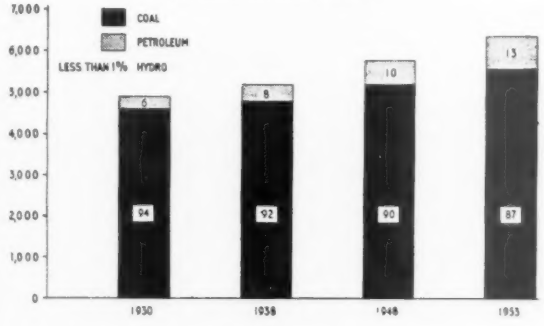
*By* C. P. DALTON†

## Introduction

It is generally agreed that if the U.K. is to prosper in the competitive world of today it must have access to a sufficient supply of reasonably-priced energy to turn the wheels of industry.

The coal crisis of 1947 is a very obvious example of the disastrous consequences of a shortage of fuel. More insidious perhaps, but of even greater consequence in the long run, would be the failure to keep pace with increases in industrial productivity abroad. Productivity is, of course, linked to energy and in recent years much has been made of the fact that workers in American industry are estimated to have two or three times as much mechanical power at their elbows

*Chart I*
*U.K. Energy Balance*
*(Million Million B.t.u.)*




as their British counterparts. Yet at the same time that British productivity teams, returning from the U.S.A., were advocating the increased use of mechanical aids, the Ridley Committee was commenting on fuel supply prospects that "in the next few years, it is likely that the country will continue to face a shortage of coal . . . . . ".

The Committee went on to report that no great relief to the fuel shortage could be expected before the 1960s from sources other than coal and oil. The petroleum industry is certainly responding to the ever-increasing demands for energy, and the contribution of black oils in particular is rapidly growing. Coal output has proved less elastic and the industry is meeting its minimum U.K. commitments only by sacrificing export sales and supplementing its production by importing supplies. Such a narrow margin in the present emphasizes the Committee's concern at prospects for the future.

The attempt to discern broad future trends in the U.K. energy situation is made in the following sections with a full appreciation of the considerable pitfalls inherent in any such forecast. It should be emphasized at the outset, however, that the objective of this paper is to provoke discussion rather than provide a work of reference.

## Present U.K. Energy Balance

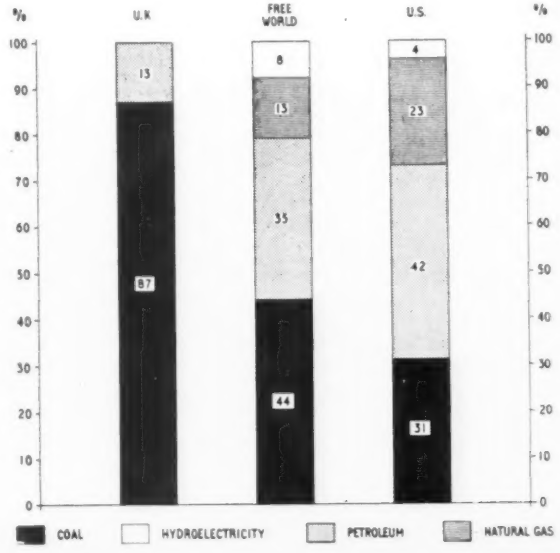
An examination of the contribution made by the primary sources of fuel and power to energy consumption is revealing. Energy balances of this sort can be calculated on the basis of either total or competitive energy. The former has been selected in this instance, partly since it is desired to show the place of petroleum in the overall energy situation, and also owing to the difficulty of knowing where to draw the line in a competitive energy balance. Petroleum products other than fuel and burning oils compete with coal, although perhaps less directly, as in the case of gasoline for automotive use versus coal for rail locomotives.

In Chart I, U.K. inland consumption of coal (including coal used in the secondary industries of gas and electricity) has been compared with inland consumption of all petroleum products, each primary fuel being converted to a common basis of B.t.u. and expressed as a percentage of the total. The contribution of hydro-electricity is relatively unimportant, amounting to less than 1 per cent of the total.

Coal is, of course, by far the most important primary source of fuel and power in the U.K., accounting in 1953 for 87 per cent of total energy consumption in its uses as a direct fuel and also by the gas and electricity industries. The contribution of petroleum is considerably smaller, but the significant thing about this chart is the increase in petroleum's share, rising from 6 per cent of total energy in 1930 to 8 per cent in 1938 and to 13 per cent in 1953.

As far as other primary sources of energy are concerned, such as hydro-electricity or natural gas, the U.K. is either poorly endowed or existing natural resources are comparatively undeveloped at present. With regard to the natural gas position, an exploration programme is under way in the U.K., in addition to which various schemes are being examined for importing natural gas from the Middle East. Any significant development in either direction would affect the U.K. energy balance but, in view of the lack of concrete evidence of success

*Chart II*
*Comparative Contributions of Primary Fuels to Energy Requirements*




*Paper read to the Institute of Petroleum, Economics and Operations Group, 16 November, 1954.

†Esso Petroleum Co. Ltd.

at this stage, this possibility has not been taken into detailed consideration for the purposes of this paper.

The extensive reliance of the U.K. on coal is emphasized by the comparison with the free world as a whole and with the United States in particular given in Chart II. In the free world, coal was still the largest single energy source in 1953 but, at present rates of progress, petroleum (excluding natural gas) is likely to displace coal from its time-honoured position by 1956.

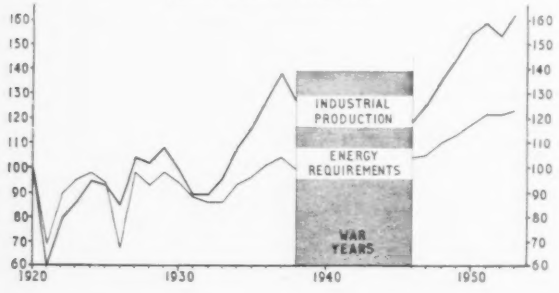
### Relationship between Energy Consumption and Industrial Activity

In the endeavour to find a basis for forecasting the future demand for energy in the U.K., an examination has been made of the past relationship between the index of industrial production and an index of energy consumption, the latter being calculated in the same way as for Chart I. These indices are shown on Chart III with 1939-1945 omitted because of the distortion caused by the war.

*Chart III*

*U.K. Industrial Production and Energy Consumption*

*(Indices with* 1920 = 100)




As might be expected, there is a marked similarity between movements in the two indices, with an upward trend in each case. An approximate relationship over the years concerned is that a 5 per cent change in industrial production has been associated, on average, with a 3 per cent change in energy consumption.

It will be noted that, since the late 1920s, industrial production has increased at a faster rate than the consumption of energy. Among the reasons for this divergence, two in particular may be mentioned. Virtually the whole of the increase in passenger and goods traffic since the 1920s has been transported by road in automotive vehicles which are considerably more efficient than coal-fired locomotives. In addition, the central generation of electricity has resulted in the more efficient utilization of increasing quantities of coal.

### U.K. Energy Demand in 1960 1963

As far as future U.K. energy demand is concerned, the period 1960–1963 provides a convenient first stop in discussing forward trends. 1960 has been selected since it seems likely that atomic power stations will still be largely in the development stage and not sufficiently progressed significantly to affect the picture. A three-year range is employed as a device for introducing some latitude to allow for the possibility of a recession in industrial activity in the intervening years.

1948 was probably the British economy's first normal post-war year. Between then and 1953, industrial production increased by 21 per cent. Bearing in mind that this period included the slight business recession of 1952, it does not appear unreasonable to assume that an increase in industrial production of at least similar magnitude will occur in the longer span 1954–1960 1963, to give a projected increase in industrial production averaging about 3 per cent a year.

Reference to the historical relationship between industrial production and energy requirements which has already been mentioned, suggests that the corresponding increase in the demand for energy will be of the order of 12 per cent. In absolute terms, the 1960 1963 demand for energy on this basis would be 7260 million million B.t.u., compared with 6450 million million B.t.u. in 1953. The 1960 1963 requirement is equivalent to approximately 270 million tons of coal, an increase of 30 million tons over 1953. Discounting the rather remote possibility of a significant development of any alternative primary source of energy in the next few years, it can be assumed that this total indicates the probable magnitude of the demand for coal and oil before the end of this decade.

### Energy Supply Sources 1960 1963

Turning to the outlook for supplying energy equivalent to 270 million tons of coal by 1960 1963, it is proposed to deal firstly with future coal supplies in order to arrive at an estimate of the balance of the energy requirement for which petroleum, as the marginal fuel, is expected to be the main supplier. Since several petroleum products compete on a direct price basis with coal, it seems desirable to consider prospects for both the volume of future coal output and for its price.

As far as the former is concerned, the present position is far from satisfactory. Chart IV shows the output of coal in the post-war years compared with pre-war, and its division between sales on the U.K. market and exports and bunkers.

The industry's production in the last few years has been comparatively static at a level slightly lower than in 1938. Coal bunkers have been largely superseded by oil firing and exports have been sandwiched between inadequate production and rising inland consumption and reduced by almost two-thirds compared with pre-war. Coal imports into the U.K. have been resumed and are expected to be at the rate of 500,000 tons a month during this winter.

The future outlook for the coal industry does not lend itself to accurate forecasting from without and, as a basis for the present discussion, it is proposed to use figures supplied by the National Coal Board to the Ridley Committee. The N.C.B. was "confident" that 240 million tons of coal a year could be produced by 1960 1965 and 260 million tons was not regarded as "outside the range of possibility". Bearing in mind subsequent performance, it would appear that actual production in 1960 1963 is unlikely to achieve the higher figure of this range; a reasonable assumption seems to be a total indigenous supply of 250 million tons, representing an average annual increase of under 2 per cent.

From their production the N.C.B. was planning to meet an export requirement of 25–35 million tons. Taking the lower export figure as being more probable, these very approximate calculations suggest a net supply of coal for disposal inland of 225 million tons.

The difference between coal supply inland of 225 million tons and total energy requirements in terms of coal of 270 million tons, would thus amount to 45 million tons. Assuming that this deficiency is to be met by petroleum, it would be equivalent to 30 million tons of petroleum products. The proportionate contribution of petroleum to total energy consumption would thereby increase to 17 per cent. In fact, by comparison with an actual increase from 10–13 per cent between 1948 and 1953, 13–17 per cent between 1953 and 1960 1963 does not appear unreasonable.

In addition to the probability of a shortage of coal against total requirements, another important factor is the upward trend in coal prices. Even in 1953, the marginal 30 million tons of coal produced incurred an average loss of nearly £1 a ton. For 1960 1963 the N.C.B. estimates that any increase in output above 240 million tons a year would involve steeply rising costs.

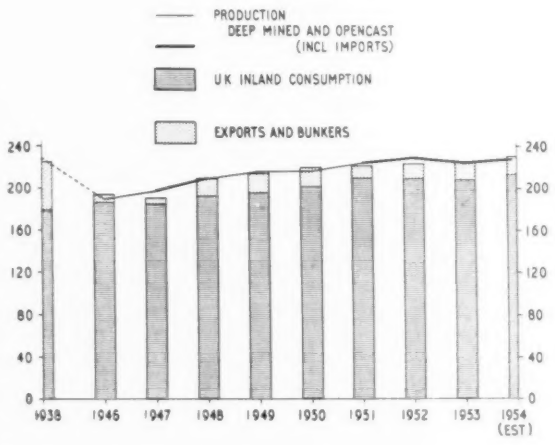
The withdrawal of coal from export markets would add to the coal industry's financial problems if coal exports continue to earn the premium over inland sales which has been a feature of the post-war years. Similarly, coal imports are undesirable on cost grounds; the N.C.B. Annual Report for 1953 stated that the loss on imported coal in that year totalled £1,100,000 or about 40s. a ton, a factor which should be given due weight when examining alternative methods of meeting the energy shortage.

These price considerations point to an increased competitiveness of petroleum products, black oils in particular, with coal, which would be reinforced by any continuation of the present trend of deteriorating coal quality.

### Longer-Term Trends

It is not intended closely to examine the longer-term future energy balance since it is in the period after 1960 that nuclear energy sources are expected to become increasingly important, sources which are not yet sufficiently developed to permit any detailed assessment of their impact. From what has been publicized to date, however, there appears to be little doubt about the future widespread use of nuclear energy for base load electricity generation, once the present experimental stage is over.

*Chart IV*
*U.K. Coal Production and Consumption*
*(Million Tons)*




The experimental nuclear power plant being constructed in Cumberland should be in operation by the end of 1956. This prototype and other work are expected to lead to extensive developments in technique, thereby smoothing the way for subsequent and improved units. Building on this foundation, it may be practicable for nuclear power stations to produce electricity equivalent to the output from 20 million tons of coal within 20 to 30 years.

Generating costs in the early stages are expected to be 1*d* per unit, compared with ¾*d* per unit for new conventional steam stations, but present information suggests that nuclear generating costs may eventually be reduced to a level competitive with that by coal generation.

Such a contribution to energy supplies would certainly be most useful from the national point of view, but it by no means implies the eclipse of conventional forms, at least in the foreseeable future. The rapid exploitation of nuclear power will be limited, not only by the initial need to develop techniques, but also by the continuing and very considerable demands which such a course would make on investment resources. The upward trend of energy requirements, even at the present rate of advance, would ensure that a contribution equivalent to 20 million tons of coal would comparatively quickly be absorbed, although not necessarily without periods of relative plenty and consequently intensified competition between the various primary sources of energy. In addition, there is the possibility that the rate of increase in future energy demand will tend to accelerate compared with that over past years if British efforts to achieve increased productivity bring our techniques more in line with the U.S. model. American consumption of energy per head is more than twice that in the U.K.; the analogy must not be too closely drawn but it does suggest that a very considerable potential demand for energy exists in the U.K., the materialization of which should ensure expanding markets in the long run for all forms of fuel and power.

### Conclusions

On the basis of the assumptions made in the foregoing analysis of broad trends, it seems possible to draw the following conclusions in respect of the early 1960s:

(*a*) The demand for energy will increase at an annual average rate of approximately 1½ per cent.

(*b*) Coal production is unlikely to meet the higher demand for energy without increased coal imports or the progressive abandonment of coal exports. In addition, increased coal output will involve steeply rising marginal production costs and for this and other reasons the trend of coal prices will continue to rise.

(*c*) It will fall mainly to petroleum, fuel oils in particular, to fill the resultant gap. Total consumption of petroleum products may rise at an average annual rate of 7 per cent and petroleum's proportionate contribution to total energy requirements can be expected to increase correspondingly.

For the late 1960s and the 1970s there is prospect of an increasing supply of electricity generated at nuclear power stations. The rising demand for energy should ensure that the newcomer is eventually absorbed by the market but an intermediate stage might entail active competition between nuclear energy, coal, and petroleum in applications for which these primary sources are direct substitutes. Such competition would be intensified to the extent that practical and economic means are developed of marketing natural gas in the U.K.

### Some Implications for the Fuel and Power Industries

Dealing firstly with gas, the policy of the industry is to meet its base load from coal carbonization and to supplement this with carburetted water gas and other production. Faced with an estimated increase in demand of 16 per cent by 1960, the industry's programme allows for an expansion of nearly 30 per cent in the capacity of water gas plant; gas oil consumption is expected to increase by 32 per cent between 1953 and 1960, from 437,000 tons to 577,000 tons. In addition, the gasification of heavy oils is at present being developed, both in place of gas oil for gas enrichment and also for the direct production of gas by a catalytic process, which has the added attraction of dispensing with coal.

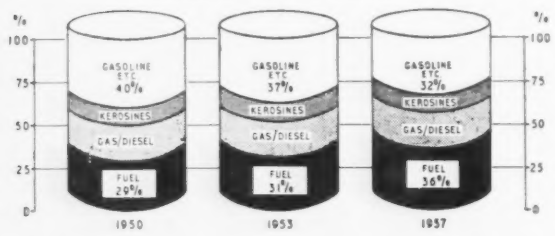
The British Electricity Authority, anticipating a market which it feels will be enlarged by over 50 per cent by 1960, has announced that it may be compelled by shortage of coal to undertake an extended use of fuel oil and is examining the desirability of installing dual firing facilities for both coal and oil with this objective in view.

Petroleum is thus likely to enjoy expanding outlets with its companion fuel and power industries. As far as industry in general is concerned, fuel oil is becoming more competitive owing to the rising cost of coal and the security offered by fuel oil against present or anticipated coal supply problems. A

switch to oil is evident which enjoys official approval—a contrast to the days when fuel oil bore a duty of 1*d* per I.G. Inland consumption of fuel oil in the first six months of 1954 totalled 2,250,000 tons, an increase of 16 per cent over the comparable period of 1953. (This comparison should be qualified to the extent that some industries were still feeling the effect of slack business in early 1953 and that the weather in the first part of 1954 was more severe than a year earlier.)

It seems fairly clear that the demand for fuel oil in the next few years is likely to grow at a faster rate than that for motor gasoline, which is depressed by the duty of 2*s*. 6*d*. per I.G. Chart V illustrates this by showing the proportionate pattern of demand faced by U.K. refiners for main products in 1950 and 1953 and an estimate of the possible position in 1957. The divergent trends in the demands for motor gasoline and for fuel oil are clearly evident. British refineries, in their future efforts to meet the increasing demand for fuel oil, may find that the absence of a satisfactory outlet for the lighter fractions imposes a limit on crude throughput and consequently the refineries' contribution to the energy problem.

*Chart V*
*Proportionate Demand for Major Products*
*U.K. Inland and Bunkers*




Apart from this probability of an increasing lack of balance between product demands, the trends which have been discussed imply the need for even greater capital investment on the part of the petroleum industry. In addition to the marine, refining, and distribution facilities normally required for expanding volume, the increasing proportion of gas and fuel oils to total deliveries may intensify problems of seasonal peaks in demand and necessitate extensive investment in tankage to cover such fluctuations.

It should also be recognized that the petroleum industry is likely to become more vulnerable to changes in business activity. In the past, the underlying trend of demand for petroleum in the U.K. has been sufficiently strong that, irrespective of setbacks to industrial production, the demand for all products together has been higher each year than in the preceding year. Petroleum's rising contribution to total energy requirements, however, carries with it an increased sensitivity to changes in business activity. The impact of a sharp recession, such as occurred in 1952, on a future fuel oil market, perhaps doubled in size, could resurrect urgent problems of fuel oil outlet.

To sum up: this review suggests a continuation of the widening horizons to which the petroleum industry has become accustomed, but it also suggests the need to ensure a high degree of flexibility. Apart from the considerations briefly mentioned of refinery balance, seasonal fluctuations in demand, and an increased sensitivity to general business conditions, there is always the possibility that an extensive development of nuclear power may permanently affect the markets for some products. To the extent that home refineries —despite the British industry's best efforts to achieve self sufficiency—find themselves unable completely to meet the new product demand patterns, marginal imports of fuel oil might find a useful place in the future energy balance.

**Discussion**

W. S. Ault opened the discussion and, after complimenting Mr Dalton on his address, suggested that efficiency in use of energy was one of the vital considerations. In this connexion, he pointed out that a 10 per cent improvement in efficiency in the case of foundry consumption could save some 10 million tons of coal and that although at first sight this might appear spectacular, in fact, existing efficiency being about 20 per cent, a 10 per cent improvement would amount to only 2 per cent overall. On the subject of efficiency Mr Ault drew attention to the existence of a thermal generator in the U.S.A. with an efficiency of 40 per cent, whereas in this country figures in the region of the thirties were favourably regarded.

With regard to the future role of petroleum, he felt that likely applications would be found in the more portable forms of power or in static plants with fluctuating loads. In this connexion and in reference to the effects of heavy fuel oil demand on refinery balance mentioned by Mr Dalton, he posed the question whether recourse to increased use of I.C. engines, using light fractions as fuel, might not have a corrective effect.

Mr Ault wondered whether Mr Dalton, by quoting official sources, had not created too pessimistic an impression as regards nuclear power and, whilst agreeing on the subject of costs, pointed to the construction of nuclear-powered submarines in America, from which he deduced that the proposition was a practicable one.

Finally, on the subject of coal Mr Ault questioned whether it was realistic to continue regarding ourselves as coal exporters and asked if it would not be more beneficial to concentrate on export of the more remunerative manufactured articles.

Replying to certain of these points, Mr Dalton said that he agreed with Mr Ault on the subject of efficiency but drew attention to the fact that the ratio between industrial production and energy consumption had already taken into account increases in efficiency in coal utilization. With regard to the future, however, he felt that at present prices there was no great incentive for industrialists to economize.

On the question of nuclear energy, Mr Dalton agreed on the difficulty of assessing future contributions of energy from that source owing to the lack of appropriate reference material. He wondered, however, whether it was correct to draw conclusions from construction of the submarine *Nautilus* as he felt it was not a proposition which could have been undertaken for commercial use.

Mr Dalton expressed himself in favour of continuing coal exports and pointed out the bearing this trade had on efficiency of shipping movements in relation to grain imports.

Next, A. R. McDowall drew attention to Mr Dalton's suggestion that future industrial production would rise 3 per cent per year and pointed out that since, on average, something approaching this rate of increase took place from 1920 to 1939 there were several reasons for thinking the rate of increase might be higher in future, in fact some authorities suggested a rise around 4½ per cent. Whilst agreeing that 3 per cent appeared plausible, Mr McDowall felt there was a danger of under-estimation and thought it quite possible that the industry would have to be prepared to supply energy in even greater quantities than suggested by Mr Dalton. Mr Dalton replied that his use of the three per cent figure was deliberate and said that use of a higher figure would serve to bring forward the 1960 picture. Whilst agreeing that this figure was conservative he felt that 4½ per cent was further than he would like to go.

After supporting Mr Dalton on this point W. Jamieson went on to emphasize the need to use more mechanical power to improve productivity in view of the shortage of labour. This consideration too, he said, would increase the Coal Board's difficulties and he thought that Mr Dalton had

probably been optimistic in his view of coal production.

In response, Mr Dalton said he sympathized with the thought that the coal production estimate of 260 million tons was optimistic, but that by reducing export requirements the availability figure would remain unchanged.

After adding his congratulations to those of Mr Ault, R. J. Bressey proceeded to enquire if there was any real justification for anticipating continually expanding economic activity at the rate suggested. Turning to the subject of the energy gap, Mr Bressey said that he thought 45 million tons was distinctly on the high side and wondered whether production of fuel burning equipment could keep pace with a growth in consumption of 3 million tons per annum. Turning to the subject of the railways, he indicated the economies possible by pointing out that 3 million tons of diesel fuel could do the same job that currently requires 14 million tons of coal and that, alternatively, electrification could have a similar effect.

Mr Bressey was of the opinion that an increase in the price of about £1 per ton would not have an appreciable effect in encouraging economies because, firstly, fuel costs were only a fraction of total production costs, and secondly, means to increase production were likely to have priority.

On the subject of the growing demand for fuel oil, Mr Bressey asked Mr Dalton what he thought was going to happen to excess light products which would be manufactured from crude oil at the same time as fuel oil, and if he had any ideas for overcoming this problem.

In reply, Mr Dalton said that although up to date some major event had always intervened to change the tempo of economic activity and perhaps atomic energy would affect our particular case, he saw no reason why industrial production should not go on increasing fairly constantly.

On the question of petroleum products, he thought an increase in all products could be expected, and pointed out that an increase of 7 per cent a year in the future would not be dissimilar to the increase between 1952 and 1953. He also agreed that in diesel traction there were big potentialities for saving coal.

C. I. Kelly then suggested that the solution to the creation of unbalanced demand would be to burn crude oil as such.

The next speaker, P. Draper, put forward the suggestion that coal should continue to be exported. He felt that it would even pay us to import fuel oil in order to do so and sought comment on the point. On efficiency, Mr Draper thought improvements in turbine efficiency were being subordinated to the need for rapidity of production. He also felt that coal was not properly regarded as a raw material and that instead of being burned in the usual fashion it should be processed first. Mr Draper also considered that efficiency of gas turbines could be much improved, particularly for generating purposes, railways, and marine propulsion, and that this form of power had a useful contribution to make.

Commenting on these points, Mr Dalton said it did appear to be an economic proposition to maintain coal exports by importing fuel oil and quoted figures to illustrate the point. Regarding the value of coal as a raw material, Mr Dalton said he thought Mr Draper's view was another argument for raising coal prices.

H. E. Barry next pointed out that the price question was a very important one and he felt that it was quite wrong for the impression to be given that the U.K. could make up the balance of its energy requirements by importing fuel on a "coal-oil" price parity. His view was that industry could have all the energy it wanted provided it was prepared to pay for it.

On the question of the contribution of oil to energy requirements, Mr Barry wondered whether a straight B.t.u. comparison did not lead to an under-estimation of the contribution, since by this method efficiency considerations were not taken into account. Mr Dalton agreed with this point and said he thought that if it had been possible to evaluate the contribution by allowing for efficiency in use the figure for petroleum would have been higher than the one chosen (13 per cent).

On coal-oil parity Mr Dalton said he found the concept not easy to grasp and that relative merits could best be judged for specific instances.

Mr Waters then commented on the subject of industrial production. He thought that the existence of full employment would make it difficult to achieve progress but that on the other hand full employment and higher wages stimulate substitution of energy for man power so that demand for energy may be a higher factor than in the past. On the subject of dieselization, Mr Waters thought that far from being in the experimental stage this had been passed at least fifteen years ago, as evidence of which he pointed to the superb diesel locomotives that were being made in the U.K.

Mr Ingles then diverted discussion to a new topic by wondering whether the U.K. could be considered in isolation without also considering Europe and the question of oil and coal prices. He thought it had been assumed oil would not displace coal but that nevertheless it might do so if the suggestions on fuel prices put forward in *The Price of Fuel** were adopted and the price relationship were closer to that of efficiency. He felt that in Europe there would be a tremendous gap in demand in the next decade, a great deal of which would have to be made up by coal; that coal would command a high export price, and that it was with this price that the cost of oil should be compared; that as the demand for coal went up, the relative position of oil would improve considerably, and that for this reason alone the demand for fuel oil would be as great as Mr Dalton foresaw.

The last speaker, P. M. de Veulle, whilst emphasizing that the subject under discussion lay to some extent in the realm of the unpredictable, also felt that there was a tendency to think too much in static and statistical terms rather than in terms of progress and change. He thought that considerable progress was being made by the Coal Board, B.E.A., etc., and that impressive progress was being made in such matters as the complete gasification as well as underground gasification of coal which, he thought, had a very substantial contribution to make to energy requirements.

Mr de Veulle also agreed with Mr Barry that price was a crucial point and felt there would have to be an upward movement in the price of fuel oil, in fact, that availability would in the long run be dependent on price.

In conclusion, Mr de Veulle proposed a hearty vote of thanks to Mr Dalton for his able exposition and to all those who had contributed to the interesting discussion.

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*Little, I. M. D. *The Price of Fuel*, Oxford: Clarendon Press, 1953.

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## SAFETY AND FACTORY EFFICIENCY

The 1955 Safety and Factory Efficiency Exhibition, the third of its kind to be held in Birmingham, is to be held at the Industrial Safety Training Centre, Museum of Science and Industry, Birmingham, from 24 June to 1 July this year.

Every aspect of safety, health, and welfare among industrial workers will be covered together with factory efficiency in the broadest sense. Among the items of protective clothing which will be shown are asbestos suits of the type used recently in a dangerous oil refinery fire.

# Petroleum in Parliament

### Consumption of Motor Spirit and Fuel Oils

In answer to a question in the House on 25 March, Mr Joynson-Hicks gave the following details of United Kingdom consumption of petrol and fuel oil for the years 1938 and 1945 to 1954 inclusive.

| — | *Motor spirit* (1000 *tons*) | *Fuel Oil* (1000 *tons*) | | |
|---|---|---|---|---|
| | | *Used in refineries* | *Other inland* | *Total* |
| 1938 . . | 4831 | 183 | 628 | 811 |
| 1945 . . | (*a*) — | 150 | 227 | 377 |
| 1946 . . | (*a*) — | 302 | 596 | 898 |
| 1947 . . | 4594 | 343 | 1936 | 2279 |
| 1948 . . | 4265 | 422 | 2742 | 3164 |
| 1949 . . | 4671 | 499 | 2795 | 3294 |
| 1950 . . | 5195 | 650 | 3093 | 3743 |
| 1951 . . | 5454 | 871 | 3418 | 4289 |
| 1952 . . | 5441 | 1256 | 3457 | 4713 |
| 1953 . . | 5740 | 1509 | 3815 | 5324 |
| 1954 (*b*) . | 5922 | 1923 | 4416 | 6339 |

(*a*) Motor spirit is included with aviation spirit in the figures published for the years 1945 and 1946.
(*b*) Provisional figures not yet published.

### Oil as a Substitute for Coal

A suggestion that the industrial loans scheme which is assisting industry to change from coal to oil in suitable circumstances, should be extended to domestic users was made during Question Time in the House on 28 March. The Minister of Fuel and Power expressed the opinion that this was a useful suggestion.

In answer to an earlier question concerning the Government's encouragement of the use of oil as a substitute for coal, Mr Geoffrey Lloyd said that he was discussing the matter with Government Departments, nationalized industries, and other public authorities. Loans were available to industrialists and the use of oil was increasing rapidly.

### Lubricating Oils

The Minister of Fuel and Power was asked in the House recently about the general trade policy which governs the import of lubricating oil from sources other than the sterling area, Western Europe, and certain other non-sterling countries from which there are no quantitive restrictions on imports of lubricating oil. The Minister was also asked to make a statement on the balance of payments considerations regarding the limitation of imports of lubricating oil.

In reply, Mr Joynson-Hicks stated that shortages of particular grades of lubricating oils were made good by imports, subject to such limitation of dollar expenditure as was required by the balance of payments position.

### U.K. Oil and Natural Gas

The Government's intention to encourage the search for oil and natural gas in the United Kingdom, and the proper development of any fields that are found, was expressed by The Minister of Fuel and Power in answer to a recent question in the House.

### Consumption of Gas, Diesel, and Fuel Oils by Nationalized Bodies

Deliveries of gas, diesel, and fuel oils to nationalized undertakings during the years 1949 to 1954 inclusive were summarized in the following manner by Mr Joynson-Hicks in answer to a recent question in the House.

| — | *National Coal Board* | *British Electricity Authority* | *Gas Council* | *British Transport Commission* |
|---|---|---|---|---|
| | | (*a*) | (*b*) | (*c*) |
| | | *Thousand statute tons* | | |
| 1949 . . | (*d*) | 54 | 510 | 310 |
| 1950 . . | (*d*) | 72 | 540 | 405 |
| 1951 . . | (*d*) | 85 | 557 | 445 |
| 1952 . . | 7 | 64 | 462 | 459 |
| 1953 . . | 10 | 95 | 454 | 467 |
| 1954 . . | 12 | 174 | 557 | (*e*) 313 |

(*a*) Consumption for generation only, including usage by the North of Scotland Hydro-Electric Board.
(*b*) Deliveries for gas making.
(*c*) Consumption by British Railways, London Transport Executive, Provincial and Scottish Bus Services, and British Road Services.
(*d*) Deliveries prior to 1952 not readily available.
(*e*) Excludes British Road Services which consumed 150,000 tons in 1953.

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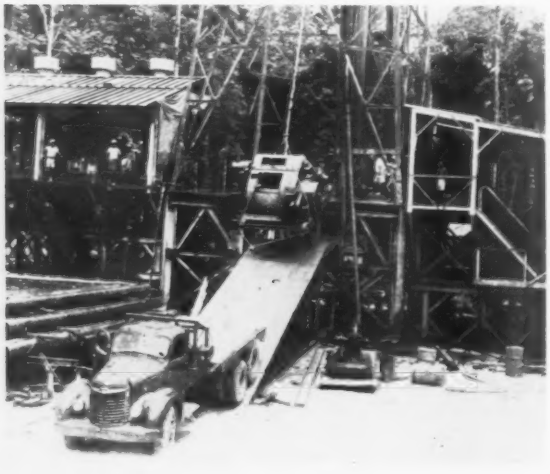

*Work in progress in a jungle area of Papua, New Guinea, where the Australasian Petroleum Company is drilling a test well which may run below 15,000 ft.*
*In this picture the Ideal Type 50 rig which was used to drill the first 7500 ft is being lowered by lines supported by the larger 130 rig which replaced it. The larger drill will enable drilling to continue to the greater depths required.*
*The equipment has been supplied by The National Supply Co. of America and after importation from U.S.A. had to be carried 270 miles across the Gulf of Papua and up the Omati River by shallow-draught freighter to the scene of operations.*

# USBM Reorganization

## Plans for Future Petroleum Research

Changes in the organization of the United States Bureau of Mines were announced towards the end of 1954 which included reorganization of the Bureau's work in regard to petroleum. New divisions and titles were created and there are now divisions in Washington dealing separately with administration, minerals, solid fuels, and petroleum (including natural gas and oil shale).

The new Division of Petroleum (which was formerly a Branch of the Bureau's Fuels and Explosives Division) is responsible for the staff work in Washington for technological research on petroleum, natural gas, and oil shale which is conducted in the field under the control of regional directors. This field work is carried out principally in the experimental stations at Bartlesville, Oklahoma; Laramie, Wyoming; Rifle, Colorado; Morgantown, West Virginia; and San Francisco, California; with field offices at Dallas and Wichita Falls.

The Division also covers work on petroleum statistics carried out for the western states in an office in San Francisco, California. Apart from this statistical work for the western states, the Division handles in Washington the statistical work for the rest of the U.S.A., and consolidates the statistics compiled at San Francisco with those for the other states, to give a national picture.

The new Division of Petroleum is split into the following Branches: (*a*) a Branch of Petroleum Production, concerned with the technology of developing and operating oil and gas fields and of storing and transporting oil and gas and their products; (*b*) a Branch of Petroleum Chemistry and Refining, concerned with the chemistry of petroleum, thermodynamics of hydrocarbons and related sulphur and nitrogen compounds, the technology of refining and petrochemical operations, and the utilization of petroleum products and natural gas; (*c*) a Branch of Oil Shale, which is concerned with the composition and properties of oil shale, shale oil, and their products, and the technology and economics of processing oil shale and shale oil and using their products; and (*d*) a Branch of Petroleum Economics which deals with statistical and economic work.

R. A. Cattell, who is chief of the new Petroleum and Natural Gas Division, has served for 34 years with the Bureau of Mines. During this time he has held the positions of superintendent of the Bureau's petroleum experimental station at Bartlesville and chief of the Helium Division in Washington, and since 1933 has been in charge of the Bureau's work on petroleum and natural gas. Until the recent reorganization this work was carried out as part of the activities of the Fuels and Explosives Division.

### Petroleum Research

In recent years petroleum research carried out by the Bureau of Mines has been concentrated on a number of specified problems. These have included studies of the use of tracers in water flooding operations, techniques of selective plugging, use of explosives in shooting wells, studies of the nature and effect of surface forces, problems of oilfield waters, research on reservoir rocks, engineering field studies, and problems connected with the underground storage of natural gas. In addition, various forms of chemical, refining, and thermodynamic research have been undertaken.

### Future Research Plans

Summarizing the future work of the Petroleum and Natural Gas Division, R. A. Cattell has said that much of the present programme, outlined above, will continue. "Closer relationship will be maintained between studies of primary and secondary methods of extracting petroleum. Work will continue on the properties of gas-condensate fields, and studies of the productivity of high-pressure oil and natural gas wells, and the behaviour of gas-storage reservoirs, will be emphasized. Pressure-maintenance problems will call for increased attention by the Bureau's petroleum-reservoir engineers. Studies of proper methods of well completion are under way and will continue. The Bureau hopes to see its work on tracers and surface forces extended, with no recession in its studies of water treatment and corrosion. Its engineers believe that much fundamental work could be done to the advantage of industry on the heat-transfer properties of reservoir rocks.

"The Division's research in chemistry and refining is long range, and the Bureau will continue to analyse crude oils and their products, with increased coverage and better quality data for producers, refiners, and consumers. The instability and incompatibility studies of distillate fuels are being extended to fuels in the gasoline range. More data on the fundamentals of fuel evaporation and combustion in the diesel cycle will be obtained to enable engine manufacturers to construct more efficient engines and refiners to manufacture better fuels; work along similar lines for jet fuels is also being planned. Fundamental researches on sulphur and nitrogen continue under the guidance of their respective API Project Advisory Committees. Surveys of the quality of commercial fuels and other technical surveys have aided industry and others and will be continued.

"Looking ahead in thermodynamics research, sulphur and nitrogen will have important places, values for the thermodynamic properties of many pure hydrocarbons are needed in the development of commercial processes, and the research on the high-pressure, high-temperature properties of the vapours of pure compounds will be strengthened to aid the petroleum and petrochemical industries.

"Plans are also being made to extend the coverage of petroleum and natural-gas statistics and reduce the time between collection of information and making the facts available to the public."

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### CORRECTIONS TO IP STANDARD METHODS

Certain corrections to the methods appearing in "Standard Methods for Testing Petroleum and Its Products", 14th Edition, 1955, have been noted. They are:

**Tetraethyl Lead in Gasoline (IP 116/55)**

**Section 8 (a).** The letter C at the top of the oil seal should be deleted. In line 3 on page 549 the letter D should be deleted.

**Section 10 (a).** In line 7, for "50 ml" read "15 ml".

# The Co-ordinating Research Council of the U.S.A.

## Institute of Petroleum to hear its story

Taking advantage of the presence in Europe in June of many Americans and others who will be attending the World Petroleum Congress, the Institute of Petroleum has organized a meeting on 30 June at which senior representatives of the Co-ordinating Research Council will present four papers under the theme The Story of the Co-ordinating Research Council Inc.

The four short papers are entitled:—

Development and Aims of the Co-ordinating Research Council (CRC). By M. K. McLeod.

Current CRC Projects. By T. B. Rendel.

What CRC means to the Automotive Industry. By E. S. MacPherson.

What CRC means to the Petroleum Industry. By W. J. Sweeney.

The meeting is to be held at the Institution of Mechanical Engineers, 1 Birdcage Walk, London, S.W.1., at 3.30 p.m., followed by light refreshments at 5 p.m. The reading of the papers will be followed by general discussion at 5.30 p.m.

**The CRC**

The CRC is a direct development of the Co-operative Research (CFR) Committee sponsored in 1921 by the undermentioned bodies:—

(*a*) The American Petroleum Institute (API) and the National Automobile Chamber of Commerce, who jointly provided the funds,

(*b*) The Society of Automotive Engineers (SAE), who provided the secretariat, and

(*c*) The National Bureau of Standards (NBS), who provided the laboratory facilities.

The object of the CFR Committee was to co-ordinate technical work on fuels between the petroleum and automotive industries.

In 1942 the CRC was formed by the API and the SAE; it was incorporated in 1943. The CRC took over the research work of the CFR Committe on fuels, of the SAE on lubricants, and of the API on automotive equipment. CFR then became a Committee of the CRC, and at the same time a new Committee—Co-operative Lubricants and Equipment Research (CLR) Committee—was formed.

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### LABOUR STATISTICS FOR THE U.K. PETROLEUM REFINING INDUSTRY

The following figures are taken from the March 1955 issue of the *Ministry of Labour Gazette* (cf. previous figures given in the *I.P. Review*, (1954, **8**, 230)).

*Figures in bold type are the averages for all the industries covered by the tables.*

| | *Men* (21 *and over*) | *Youths and Boys* | *Women* (18 *and over*) | *Girls* | *All Workers* |
|---|---|---|---|---|---|
| No. of wage-earners covered by remuneration statistics | 17,121 | 637 | 816 | 19 | 18,593 |
| Average earnings in last pay-week in October 1954 (shillings) | 211/9<br>**204/5** | 83/6<br>**85/7** | 113/0<br>**108/2** | —<br>**69/5** | 202/10<br>**171/9** |
| Average number of hours worked in this pay-week | 48·7<br>**48·5** | 47·3<br>**44·9** | 45·4<br>**41·9** | —<br>**42·8** | 48·5<br>**46·7** |
| Average hourly earnings in this pay-week (pence) | 52·2<br>**50·6** | 21·2<br>**22·9** | 29·9<br>**31·0** | —<br>**19·5** | 50·2<br>**44·1** |
| | | | *Males* | *Females* | |
| Numbers employed (Jan. 1955) | | | 31,900 | 6,800 | 38,700 |
| Numbers unemployed (at 14 Feb. 1955) | | | 196 | 25 | 221 |
| Labour turnover rate (5 weeks ended 1 Jan. 1955) | | | | | |
| No. of engagements per 100 employed | | | 0·9<br>2·0 | 1·6<br>2·6 | 1·0<br>2·2 |
| No. of discharges and other loss per 100 employed | | | 0·8<br>1·9 | 2·5<br>3·8 | 1·0<br>2·5 |

# Notes of the Month

### Petroleum Exhibition Tours Schools and Colleges

Shell Petroleum Company's portable photographic exhibition, "Science in the Petroleum Industry", which has been touring during the past year, has already visited many schools and colleges throughout the country. The exhibition consists of ten panels dealing with the application of the sciences in the petroleum industry. Its aim is to give older schoolboys and undergraduates some indication of the scientific fields open to them if they wish to make a career in the oil industry.

### Further Appointments to Iranian Companies

The Boards of the Iraanse Aardolie Exploratie en Productie Maatschappij (Iranian Oil Exploration and Producing Co.) N.V. and Iraanse Aardolie Raffinage Maatschappij (Iranian Oil Refining Co.) N.V. have been made up to their full complement of seven directors for each company by two recently-announced appointments. Rahmatollah Ghavami has joined the Board of the exploration and production company, and Mahmood A. Poozeshi has joined the Board of the refining company.

### Curacao Prices for Petroleum Products

The Shell Petroleum Co. Ltd. has announced the following export prices (effective since 21 March) for petroleum products free on board at Curacao, Netherlands Antilles. Each price is given per U.S. gallon at 60 F, except "C" fuel which is quoted per barrel of 42 U.S. gallons at 60 F.

| | *Price f.o.b. Curacao, Netherlands Antilles U.S.c per U.S. gallons* |
|---|---|
| **Aviation Fuels** | |
| (i) Aviation Gasoline | |
| Avgas 115/145 grade | 17·50 |
| ,, 108/135 grade | 17·25 |
| ,, 100/130 grade | 16·00 |
| ,, 91/96 grade | 14·50 |
| ,, 80 leaded grade | 14·25 |
| ,, 73 clear grade | 14·25 |
| (ii) Aviation Turbine Fuels | |
| Avtag JP-4 | 9·0 |
| Avtur | 9·5 |
| **Motor Gasolines** | |
| 83 Octane (Research Rating) | 9·875 |
| 79 Octane (Research Rating) | 9·75 |
| 70/72 Octane (Motor Method) | 9·5 |
| **Kerosine and Light Fuels** | |
| Tractor vaporizing oil | 9·5 |
| Kerosine 41°-43° A.P.I. (Water White) | 9·5 |
| No. 2 Fuel | 9·0 |
| **Diesel and Gas Oils** | |
| 53 Diesel Index (minimum) | 9·25 |
| 48 Diesel Index (minimum) | 9·125 |
| 43 Diesel Index (minimum) | 9·0 |
| | *U.S.$ per barrel of 42 U.S. gallons* |
| **Heavy Fuels** | |
| Bunker "C" fuel oil | 1·95 |

### Butane Distributing Company acquired by Shell-Mex and B.P.

Bottogas Ltd., a company which distributes commercial butane as bottled gas for domestic purposes and manufactures related appliances and fittings, has been acquired by Shell-Mex and B.P. Ltd. The Company, with its predecessor Spensers (London) Ltd., has been in operation in this field for nineteen years and for the present will continue to operate on the same lines as before.

The Board of Bottogas Ltd. is now as follows: C. M. Vignoles, O.B.E. (Chairman), C. T. Brunner, F. A. Keeling, A. M. MacKintosh, O.B.E., M.C., R. J. Bressey, A. N. Macaulay, S. C. Green, and A. G. I. Anderson.

The General Manager is Mr Macaulay.

### United Kingdom Oil

Ruskington, near Sleaford, Lincolnshire, has been chosen as the site for the latest test well to be drilled by the D'Arcy Exploration Company, The British Petroleum Company's exploring subsidiary. This is the first well to be drilled in the area.

A second shallow well is being drilled at Chaldon Herring, to obtain supplementary geological information about the Dorset area.

### Testing Atomic Power Station Plant

Relieving stress in a reactor casing—a huge cylindrical vessel—to be used in the new atomic power station at Calder Hall presented a serious problem to the manufacturers of the vessel—Whessoe Ltd. of Darlington. No gas-heated furnace was sufficiently large for the vessel which was 40 ft in diameter, 60 ft high, and 400 tons in weight.

The solution found was to heat the vessel electrically by

*The Scammell "Constructor" illustrated here is carrying oil well drilling and servicing equipment made by Woodfield Hoist and Associated Industries Ltd. The rig is for servicing wells to a depth of 7000 feet. It has a telescoping mast which can be left at a well site independently of the vehicle and draw-works. The inset picture shows the "Constructor" carrying another rig with a 65-ft double-pole telescopic mast. This vehicle is suitable for carrying rig for servicing wells 4000 to 6000 ft in depth.*

means of a network of stainless steel tubing, 2,000 ft in length, inside the vessel. A heavy electric current passed through this tubing raised the temperature to the point required and was maintained for some hours to complete the process. It was then allowed to cool gradually to normal temperature.

To conserve heat during the operation and to ensure that an even temperature was reached at all points, the whole of the outer surface of the vessel was covered with insulating material several inches thick.

*Prof Boldrini, President of the Fourth World Petroleum Congress and Chairman of the general organizing committee, addressing a press conference of foreign and Italian journalists. On the President's right are Gr. Uff. D'Amelio and Prof Pennavaria, vice-chairman of the General Organizing Committee, and on his left, Dr Cazzaniga, also a vice-chairman of the General Organizing Committee, and Dr Muston, general secretary of the Congress.*

### Heat Exchangers for Iraq

Iraq Petroleum Co. Ltd. is to instal a large number of air-cooled heat exchangers at pumping stations on the pipeline from the Kirkuk oilfield to the sea terminals on the Mediterranean.

The heat exchangers will be supplied by Head Wrightson Processes Ltd. and will be used to cool diesel engine jacket water.

### U.K. Petrol Prices

The basic price of petrol, excluding tax, in Britain today is one of the three lowest in Europe, and its quality is much higher than it was before the war. These statements were made recently by E. W. Hardiman, regional manager of Esso Petroleum Company Ltd.

Mr Hardiman said that much of the price reduction had taken place since 1953 when the Government control of petrol prices was removed. Two gallons of present home-refined petrol would, he claimed, produce power equivalent to three gallons in 1925.

Oil, in particular heavy fuel oil, would play a vital role in meeting Britain's future energy requirements, said Mr Hardiman, but outlets must be found for the lighter products. Road development would provide one such outlet, but scarcely less important would be a reduction in the rate of taxation on these fuels—a tax which acted quite definitely, if indirectly, as a tax on heavy fuel oil, by restricting the use of petrol and diesel oil.

### New South Bank Offices

G. T. Meller, manager of the Office Management Department of Shell Petroleum Co. Ltd., and G. T. Bartlett, manager of Shell Estates Ltd., are included in a team of six experts who are flying to New York to study latest developments in office building construction.

The aim of their visit is to collect ideas which can be adapted in the construction of a modern block of offices on the South bank of the Thames. The sub-soil strata of the site is at present being tested.

### Prices for Venezuelan Crude

Compania Shell de Venezuela have quoted the following prices, effective from 1 March 1955, for Venezuelan crude oil cargoes delivered free on board vessels in specified ports:

| *Crude* | *Gravity °API* | *$ per brl* | *F.o.b.* |
|---|---|---|---|
| San Joaquin . . | 41·0 41·9 | 3·04 | Puerto La Cruz |
| Oficina . . . | 32·0 32·9 | 2·82 | Puerto La Cruz |
| Paconsib . . | 33·0 33·9 | 2·70 | Cardon |
| Lagomar . . | 29·0 29·4 | 2·45 | Cardon |
| Mara . . . | 29·5 29·9 | 2·40 | Cardon |
| Cabimas . . . | 22·0 22·4 | 2·15 | Cardon |
| Lagunillas . . | approx. 15 | 1·85 | Cardon |
| Bolivar District Heavy | 12·5 12·9 | 1·65 | Cardon |

These prices will increase with increases in the API gravity of the crude delivered above the low of the gravity range specified for that crude, or decrease with decreases in the API gravity of the crude delivered below the high of the gravity range specified for that crude. For San Joaquin, Oficina, and Paconsib crude oils price will vary $0·02 per brl, for each full degree API. For Lagomar, Mara, and Cabimas crude oils it will vary $0·025 per brl for each full half degree API. For heavier crude oils (excluding Lagunillas for which the price does not vary with gravity), the price will vary $0·035 per brl for each full half degree API.

### B.P.'s Fifth Platformer

A new platformer, the British Petroleum Company's fifth, was commissioned at the Kent Oil refinery, Isle of Grain, during March. The unit, which produces a high-grade motor spirit component, has a capacity of 250,000 tons a year.

B.P.'s other platformers are at Aden, Kwinana, Lavera, and Hamburg. A sixth is almost ready for use at Llandarcy refinery and the foundations for a seventh are being laid at Porto Marghera refinery near Venice.

### Increase in B.P. Refinery Output

U.K. refineries of The British Petroleum Co. Ltd. last year processed well over a million tons more oil than in 1953. The provisional total for 1954 is 10,560,000 tons compared with 9,327,000 tons in 1953, and 6,788,000 tons in 1952.

### Grange Chemicals Ltd.

British Petroleum Chemicals Ltd., jointly owned by The British Petroleum Co. Ltd. and The Distillers Co. Ltd., has formed with the Oronite Chemical Co. of San Francisco a new company named Grange Chemicals Ltd.

Grange Chemicals Ltd. are to take over the plant which is being built by British Petroleum Chemicals at Grangemouth for production of alkylate—used in the manufacture of synthetic detergents. The plant is to be commissioned towards the end of 1955.

### British Petroleum Company considers Segas Project

South-Eastern Gas Board and the British Petroleum Co. Ltd. are to consider the building of a plant to convert petroleum products from BP's Kent Oil refinery to town gas by the Segas process. If the plan comes into practice it will result in an estimated saving of some 700,000 tons of coal per year.

The first large-scale unit for the catalytic gasification of oil came into operation in February 1953, after extensive experiments by the South Metropolitan Gas Company and, later,

by the South-Eastern Gas Board. The process, which involves the use of a lime-bauxite catalyst, has been developed so that it is possible to convert a wide range of petroleum products, from butane to heavy fuel oil, to town gas.

It is proposed that the new plant should be situated near the Kent Oil Refinery to ensure a regular feedstock in whatever form is available from the refinery.

The initial installation would probably convert some 50,000 tons of petroleum products to gas annually, producing a daily output of 15 million cubic feet of gas. Extensions are envisaged up to a capacity of 40 to 45 million cubic feet per day, using up to 150,000 tons of petroleum products.

The gas would enter the South-Eastern Gas Board's grid system near Strood, and would serve the whole of South London extending to Guildford, Horsham, Maidstone, and Rochester. The grid is being developed rapidly and will cover an area of about 1750 square miles and serve four million people.

Other gas boards have ordered Segas gas-from-oil plants for use in their own areas.

### New Breakdown Vehicles for Borneo

The first of four £8500 vehicles fitted with specially designed breakdown equipment has been sent to the Seria oilfield in British Borneo. The equipment has been designed and manufactured by M. O. Harper Ltd. of Guildford in collaboration with Shell engineers. Previously such equipment had been made only in the U.S.A.

Similar equipment, on a Leyland chassis, has been ordered by the Shell D'Arcy Petroleum Development Company of Nigeria Ltd. for use in exploration work in Nigeria.

The new equipment consists of a power-driven crane, with twin jibs and a specially-designed all-steel body, carried on a six-wheeled, six-wheel-drive Scammell "Constructor" vehicle fitted with Darlington Model 70 winches.

Power for the crane is from a power take-off on the truck gearbox and drives two clutch-operated reversing gearboxes—each connected to a 10,000-lb winch. The reversing boxes and winches are built into the crane structure, one winch for each jib, and each box incorporates a double multiplate clutch connected to an operating lever on either side of the vehicle. Thus either one or both jibs can be operated simultaneously from either side of the vehicle.

*The Scammell "Constructor" fitted with special winching and breakdown equipment.*

Scammell "Constructors" have already been used with similar heavy winches and oilfield equipment but these machines, with their very powerful winching capacity, will be particularly suitable for operational oilfield work such as the laying of pipelines, erecting of drilling rigs, and recovery of breakdowns in the jungle.

### New Geophysical Survey Company

Adastra Hunting Geophysics Ltd. is the name of a new company of the Hunting Group which is to carry out airborne geophysical surveys in Australia.

The Company has been formed by Adastra Airways Pty Ltd. of New South Wales, and Hunting Geophysics Ltd. of London. It is the first airborne geophysical company to operate in Australia and has already begun work on a comprehensive aeromagnetic survey for the Department of Mines, South Australia.

*The search for oil in Italy is not new and the above photograph, taken in* 1899, *shows two oil wells at Ozzano. The one in the foreground is obviously a hand-operated pumping well.*

### First Motor Spirit from Kwinana

The first motor spirit from Australia's new B.P. refinery at Kwinana was recently pumped along the six-inch, 17-mile-long pipeline to storage tanks in Fremantle.

Two pipelines link Kwinana refinery with Fremantle. The second, which is 12 inches in diameter and 15 miles in length, carries diesel and fuel oil to marine bunkering installations at Fremantle Harbour.

### Iranian Production and Refining Figures

Figures issued by Iranian Oil Participants Ltd. for Iraanse Aardolie Exploratie en Productie Maatschappig (Iranian Oil Exploration and Producing Co.) N.V. show that 973,000 long tons of crude oil were produced in South Iran during February—a daily average production of 263,000 barrels a calendar day.

During the same period 614,000 long tons were refined at Abadan by the Iraanse Aardolie Raffinage Maatschappij (Iranian Oil Refinining Co.) N.V. This was a daily average throughput of 167,000 barrels a calendar day.

### B.P. Platformate Splitter Unit

A platformate splitter unit is to be built by W. J. Fraser and Co. Ltd. for the British Petroleum Company's refinery on the Isle of Grain.

### CRUDE OIL PRODUCTION

| | 1955 | |
|---|---|---|
| | *Feb.* | *Jan.-Feb.* |
| Kern Oil Co. Ltd.: | *Brl.* | |
| California . . . . . | 93,301 | |
| Trinidad . . . . . | 73,951 | |
| | *Tons* | |
| Iraq Petroleum Co. Ltd. . . | 1,791,103 | 3,780,962 |
| Basrah Petroleum Co. Ltd. . . | 510,483 | 968,675 |
| Mosul Petroleum Co. Ltd . . . | 99,549 | 204,385 |
| Kuwait Oil Co. Ltd. . . . | 4,109,970 | 8,354,713 |
| Qatar Petroleum Co. Ltd. . . | 407,367 | 812,814 |

# Situations Vacant

**Managerial Personnel needed for Research Centre in the Petroleum Industry**

**Ente Nazionale Idrocarburi (E.N.I.)** has under its supervision a number of Italian Companies active in the field of petroleum and petrochemicals. ENI's major activity is centred in the following items:

— gas and oil field exploration and exploitation (current production: 105 billion cu. ft. of natural gas per year);
— operator of a 2500-mile pipeline system (capacity over 700 million cu. ft. per day);
— owner and operator of a tanker fleet of around 120,000 dwt;
— owner and operator of an extensive network for distribution of petroleum products and LP gas throughout Italy (64 bulk plants, 4000 stations, etc.);
— control over or shareholding in refineries having a processing capacity of about 6 million tons of crude oil per year;
— owner of factories (1500 employees) for construction of machinery;
— shareholding of chemical plants (700 employees) for production of synthetic dyes, detergents, etc.;
— under construction, a petrochemical plant (production capacity—30,000 tons per year of synthetic rubber and 350,000 tons per year of ammonium nitrate).

E.N.I. is organizing a big research centre for investigation and development of petroleum processing and manufacture of petrochemicals. Some departments are expected to begin operation next summer.

Italian or foreign technical experts, with a wide educational background, specific training, organizational and managerial ability, are required to fill positions as heads of the main departments of the laboratories.

Specifically, the following are sought:

(1) **Chemist** or **physicist** with specific knowledge and experience in thermodynamic and chemico-physical problems;
(2) **Chemist** specialized in the preparation of organic compounds, particularly those derived from hydrocarbons;
(3) **Inorganic chemist** soundly and completely acquainted with modern methods of experimentation, research, and testing;
(4) **Engineer or industrial chemist** specially trained in the methods for improving petroleum products applications;
(5) **Engineer or physicist,** with physico-technical and technological training, specialized in the problems of thermotechnics, measurements, and controls;
(6) **Engineer or industrial chemist** with extensive research experience in the field of crude oils processing;
(7) **Engineer or industrial chemist** particularly experienced in extending laboratory procedures to pilot plants;
(8) **Engineer** with good theoretical knowledge and laboratory experience in engine tests on fuels and lubricating oils;
(9) **Engineer or industrial chemist** specially trained both in theory and practice in the fields of corrosion and protective means for materials.

*Note.*—University degree mandatory.

Applications should state age and other usual personal data, educational background and qualifications, practical experience, etc., and should include a photograph. Please address personally to the: **Presidente dell'Ente Nazionale Idrocarburi, Via Lombardia, 43-Roma-Italy,** with the special note **RISERVATA PERSONALE** (*i.e.*, to be opened by addressee only).

Absolute discretion in every respect is assured.

Salary offered will be in accordance with position, training, and qualities required.

An oil company in the British West Indies has a vacancy for an experienced **Tank Erector.** Applicants should have served a full apprenticeship with a recognized firm of storage tank manufacturers, followed by not less than ten years' experience in the erection of welded and riveted tanks up to 150,000 brl capacity. Applicants should have a good general education and be not more than 40 years of age. Starting salary in accordance with experience and qualifications, but not less than £800 p.a., with marriage and family allowances where appropriate, pension scheme, and excellent staff amenities. Apply with full particulars to Box 1089.

An oil company in the British West Indies has the following vacancies for **Mechanical Engineers**:

(*a*) For maintenance work on process plants.
(*b*) For maintenance work on light and heavy transport, I.C. and diesel.

Applicants should have served a full apprenticeship followed by not less than five years' experience on *either* (i) construction of pressure vessels, heat exchangers, or other major refinery equipment *or* (ii) refinery or chemical plant maintenance *or* (iii) heavy vehicle maintenance. Applicants should hold H.N.C. in Mechanical or Automobile Engineering, and should be not more than 35 years of age. Salary will be in accordance with qualifications and experience, but will be not less than £750 p.a. initially, with marriage and family allowances where appropriate, pension scheme, and excellent staff amenities. Apply with full particulars to Box 1088.

**Draughtsmen**—Piping and Plant Layout. Up to £20 per week offered by large engineering Company in London for suitable applicants. Five-day week. Staff canteen. Write to Box No. 1092.

**Petroleum Technologist.** A vacancy occurs in the London office of a Trinidad oil producing company for a senior qualified petroleum technologist with some geological background and administrative experience. The post is pensionable and the salary will be in accordance with experience and qualifications. Reply to Box 1091.

**Vacuum Oil Company Limited** invites applications for the post of Production Superintendent at its Birkenhead Works. Applicants must have a degree in Chemical Engineering and not less than seven years' experience in the petroleum industry in Works or Refinery operations.

The post carries the responsibility for the production of oils and greases and thereby requires a person of good personality, organizing ability, and leadership.

The Company provides an excellent Pension and Life Assurance Scheme and other employee benefits. Written applications giving details of age, experience, qualifications, and salary requirements to Employee Relations Department, Caxton House, Westminster, S.W.1 quoting Ref. No. PS 608.

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*Continued from p.* 102

and facilities at the schools are called for, and again far wider knowledge of what a technical education can command, but this brings me back full circle to the need for science teachers.

If we want more science mathematics teachers below University level we have got to pay for them. That was emphasized by the F.B.I. in a recent memorandum to the Minister, but their proposals were whittled down.

To go back to the question of what is to be done about the problem, it seems to me that we must first get an adequate flow and having achieved that, we should ensure a balanced supply into teaching and industry respectively.

I have suggested that we should be critical of the use of scientists in our own industry, and I should like to ask others to be equally critical.

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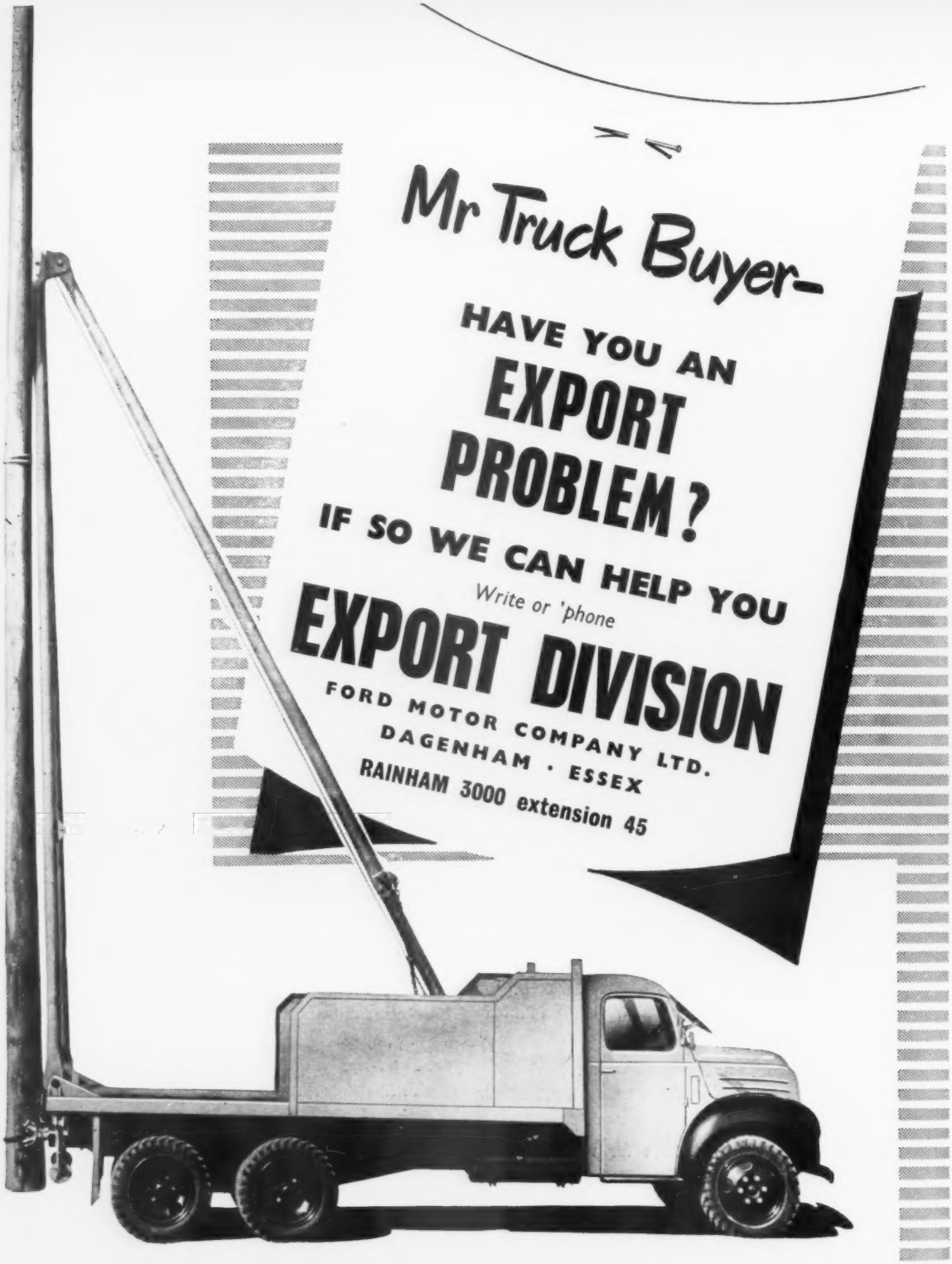


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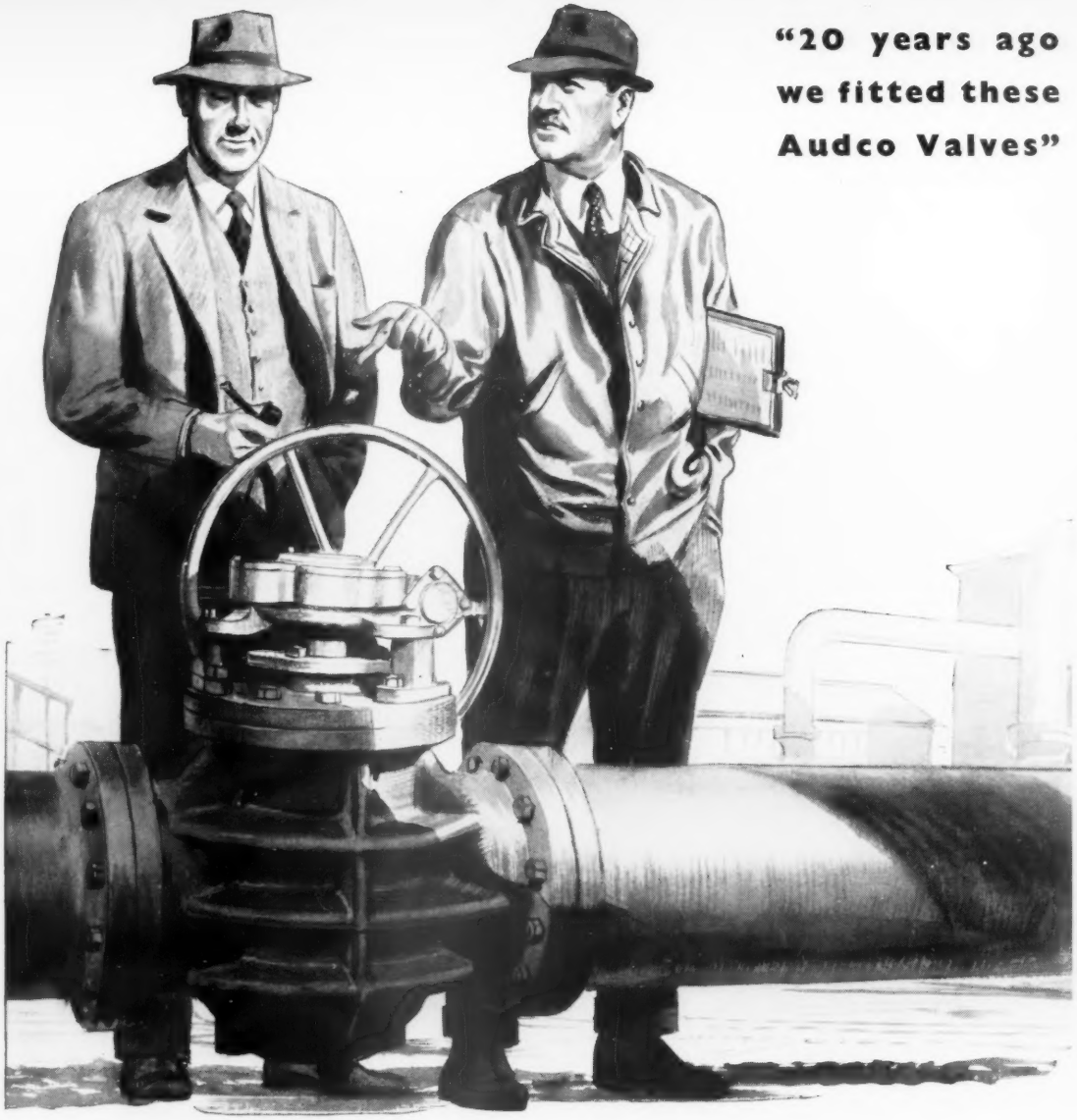

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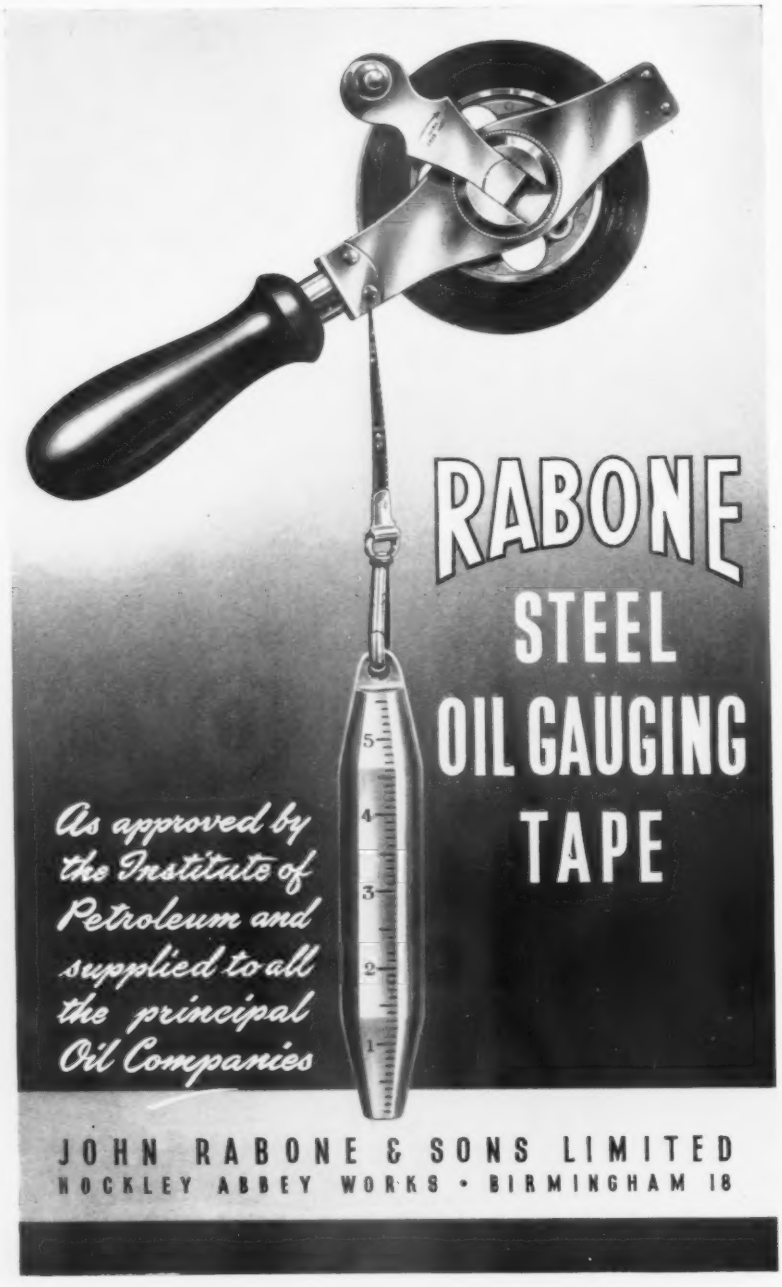
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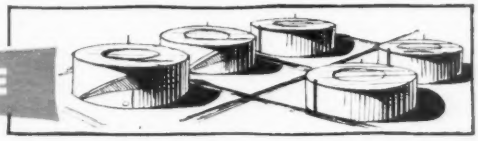

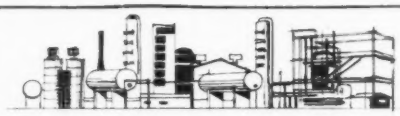

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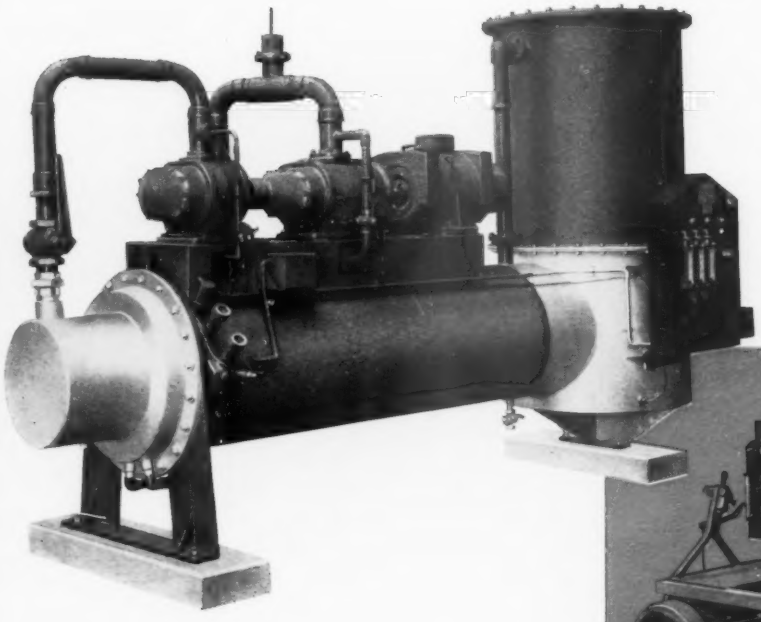

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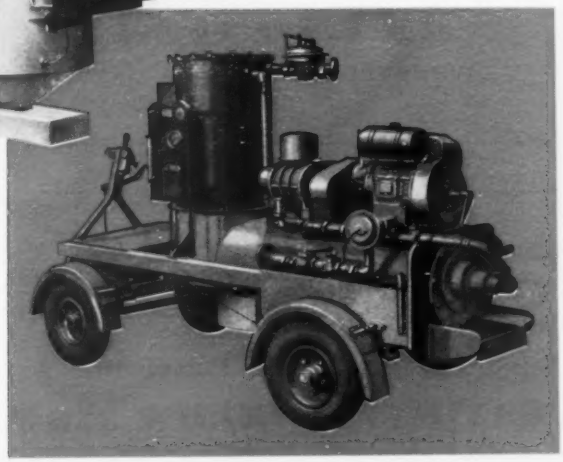

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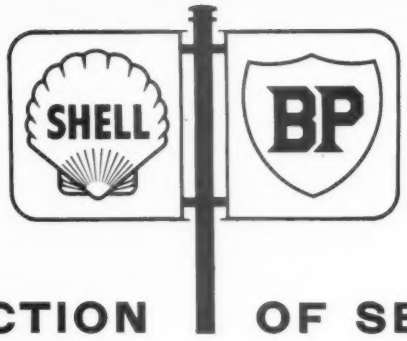


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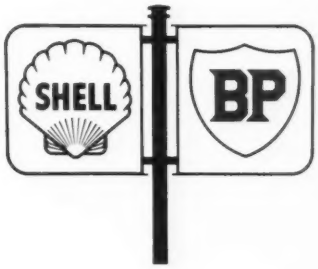


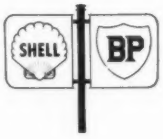


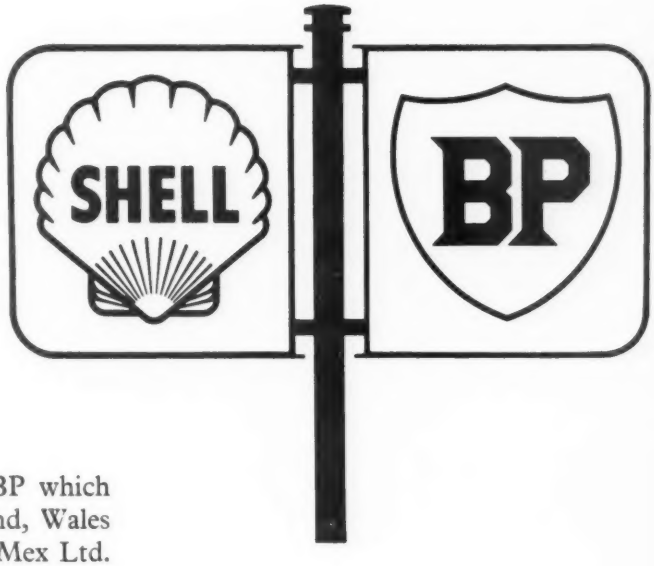


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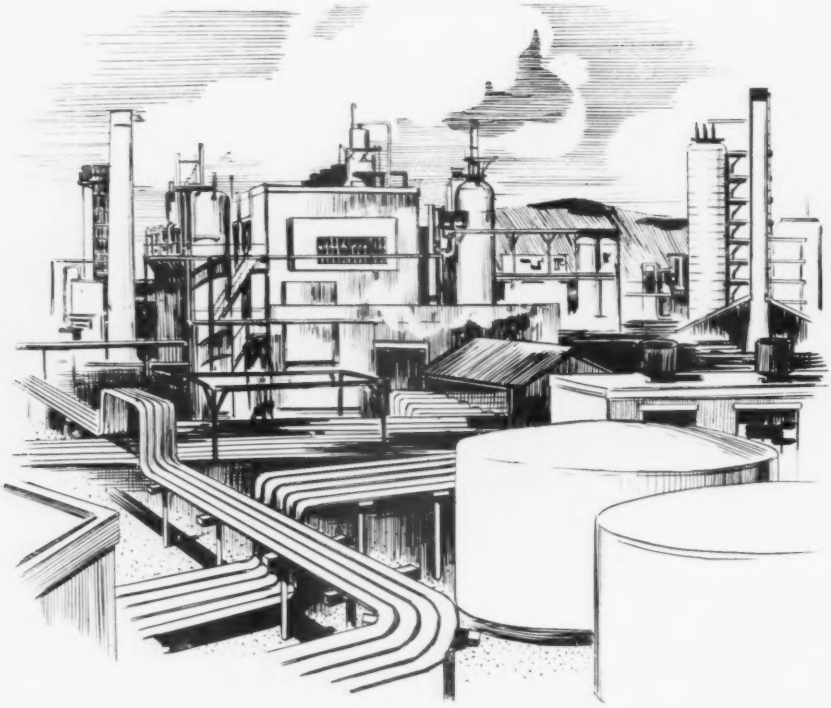

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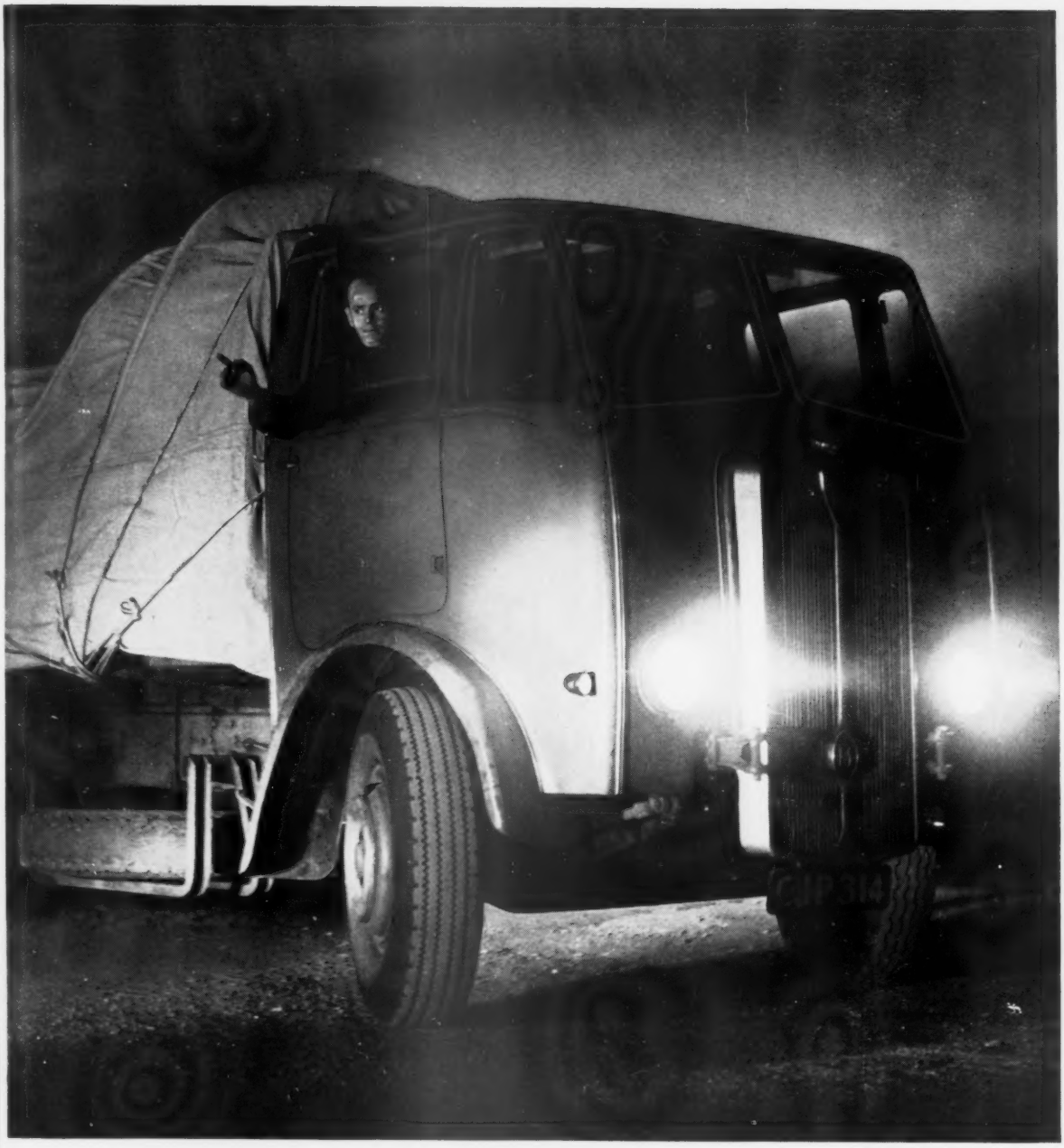

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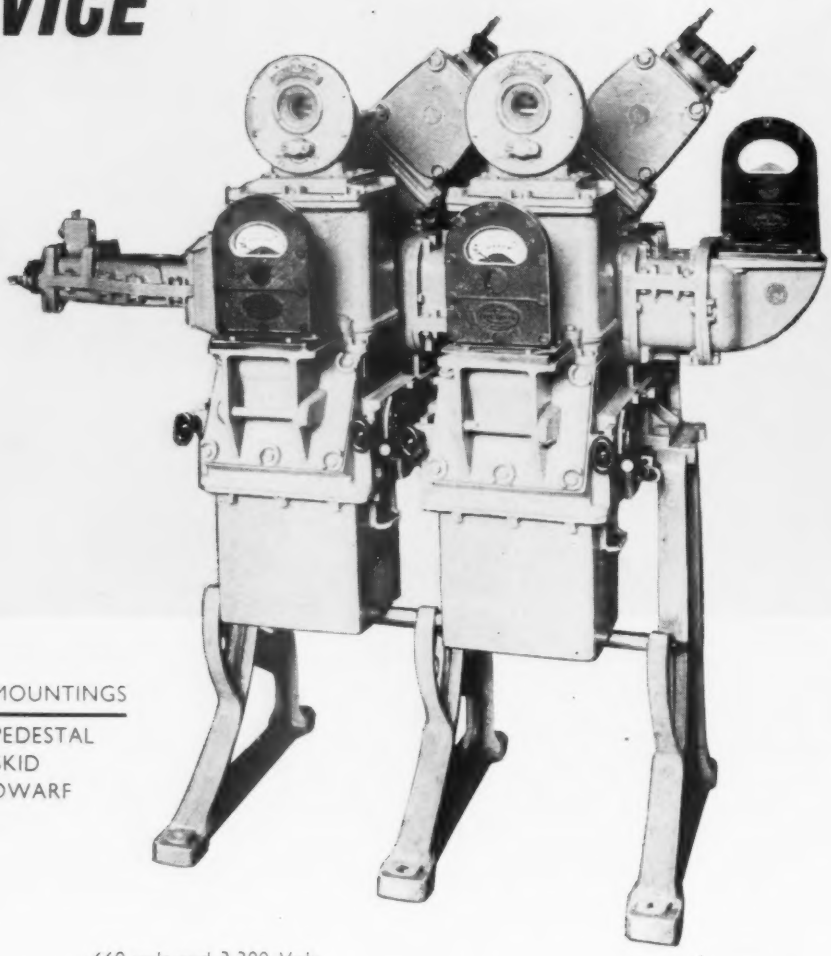

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